US011462846B2

(12) **United States Patent**
Seo et al.

(10) **Patent No.: US 11,462,846 B2**
(45) **Date of Patent: Oct. 4, 2022**

(54) **ELECTRONIC DEVICE INCLUDING CONDUCTIVE STRUCTURE CONNECTING ELECTRICALLY GROUND LAYER OF FLEXIBLE PRINTED CIRCUIT BOARD AND GROUND LAYER OF PRINTED CIRCUIT BOARD**

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(72) Inventors: **Seunghan Seo**, Suwon-si (KR); **Jongpil Lee**, Suwon-si (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2 days.

(21) Appl. No.: **16/659,970**

(22) Filed: **Oct. 22, 2019**

(65) **Prior Publication Data**

US 2020/0127404 A1 Apr. 23, 2020

(30) **Foreign Application Priority Data**

Oct. 23, 2018 (KR) 10-2018-0126469

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01R 12/77 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H01R 12/775*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 5/314*** (2015.01); ***H01Q 21/06*** (2013.01); ***H01R 12/62*** (2013.01); ***H01R 12/79*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/775; H01R 12/79; H01R 12/62; H01R 4/02; H01Q 21/06; H01Q 5/314;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,265,719 B1 *	9/2007	Moosbrugger	.... H01Q 21/0025 343/700 MS
8,411,462 B2	4/2013	Jang et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

CH	108604722	*	2/2016
KR	10-2008-0023554		3/2008

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion dated Feb. 7, 2020 in counterpart International Patent Application No. PCT/KR2019/013891.

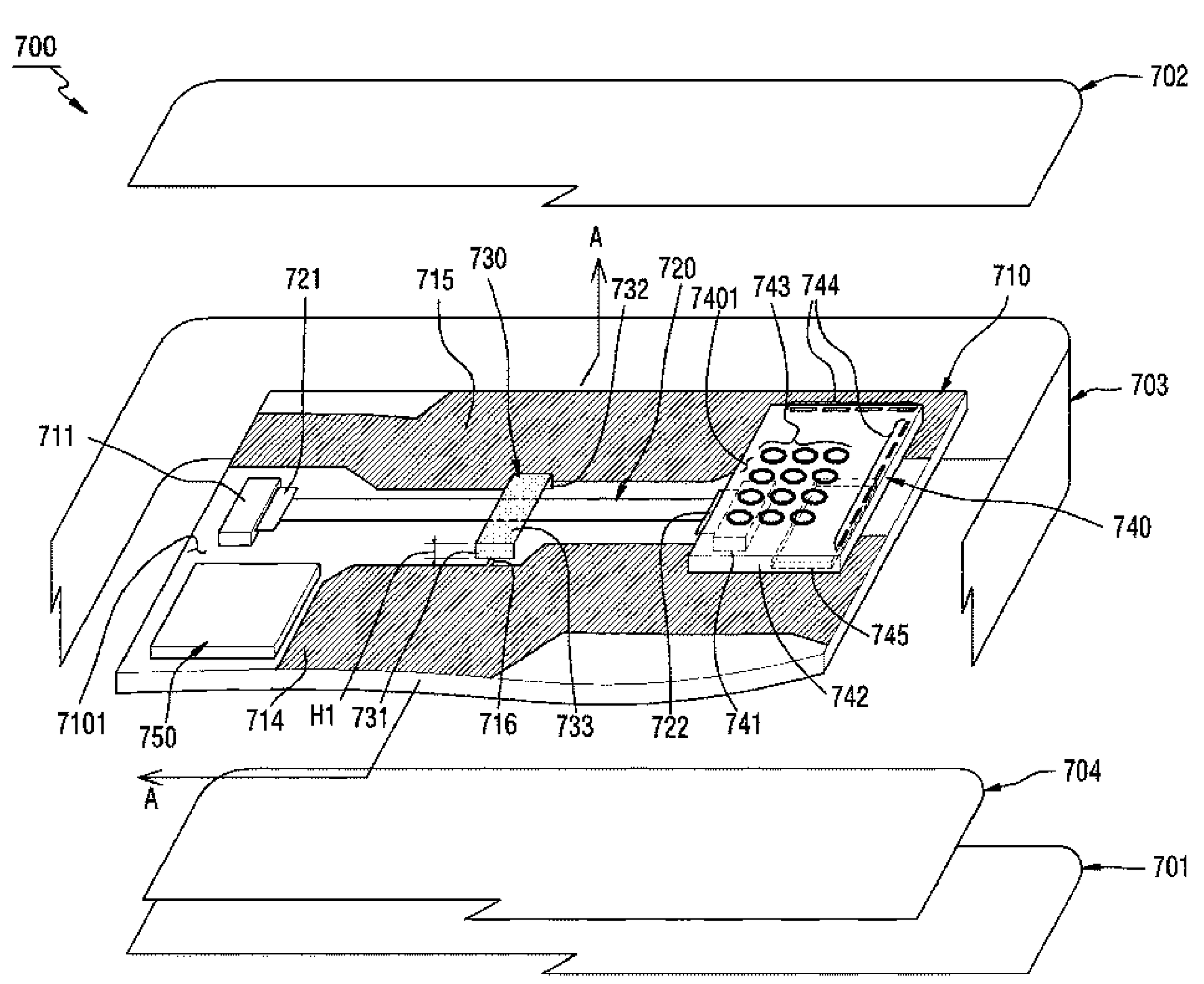
(Continued)

Primary Examiner — David E Lotter
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

(57) **ABSTRACT**

According to various embodiments, an electronic device may include a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or provided integrally with the second plate, a display viewable through at least part of the first plate, a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer, a Flexible Printed Circuit Board (FPCB) at least partially overlapping the first PCB when viewed from above the first plate and including a first end electrically coupled to the first PCB, a second end, and at least one second ground layer, and a conductive structure comprising a conductive material disposed between the first PCB and the FPCB and electrically coupling the first ground layer and the second ground layer.

19 Claims, 19 Drawing Sheets



(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H01R 12/79 (2011.01)
H01Q 5/314 (2015.01)
H01R 12/62 (2011.01)

(58) **Field of Classification Search**
CPC H01Q 1/38; H01Q 5/42; H01Q 1/243; H01Q 21/08; H01Q 21/065
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0050490	A1	3/2006	Ootani	
2008/0053713	A1*	3/2008	Huang	H05K 1/147 178/18.03
2008/0062661	A1	3/2008	Choi et al.	
2010/0240327	A1	9/2010	Lambrecht et al.	
2011/0003622	A1	1/2011	Hwang	
2012/0325524	A1*	12/2012	Naganuma	H05K 3/4691 174/254
2014/0266973	A1*	9/2014	DeVries	H01P 11/001 343/893
2016/0261023	A1	9/2016	Di Nallo et al.	
2017/0358847	A1	12/2017	Cho et al.	
2018/0026341	A1*	1/2018	Mow	H04B 10/90 343/702
2018/0288203	A1	10/2018	Jeon et al.	
2019/0027808	A1*	1/2019	Mow	H04R 1/025
2019/0228404	A1*	7/2019	Wang	G06Q 20/204
2019/0229404	A1*	7/2019	Xia	H01Q 21/08
2019/0260127	A1*	8/2019	Shi	H01Q 1/243
2020/0021015	A1*	1/2020	Yun	H01Q 25/00
2020/0225295	A1*	7/2020	Hyun	H02H 3/33

FOREIGN PATENT DOCUMENTS

KR	10-1624916	5/2016
WO	2017/146497	8/2017

OTHER PUBLICATIONS

European Extended Search Report dated Jul. 20, 2021 for EP Application No. 19876629.7.

* cited by examiner

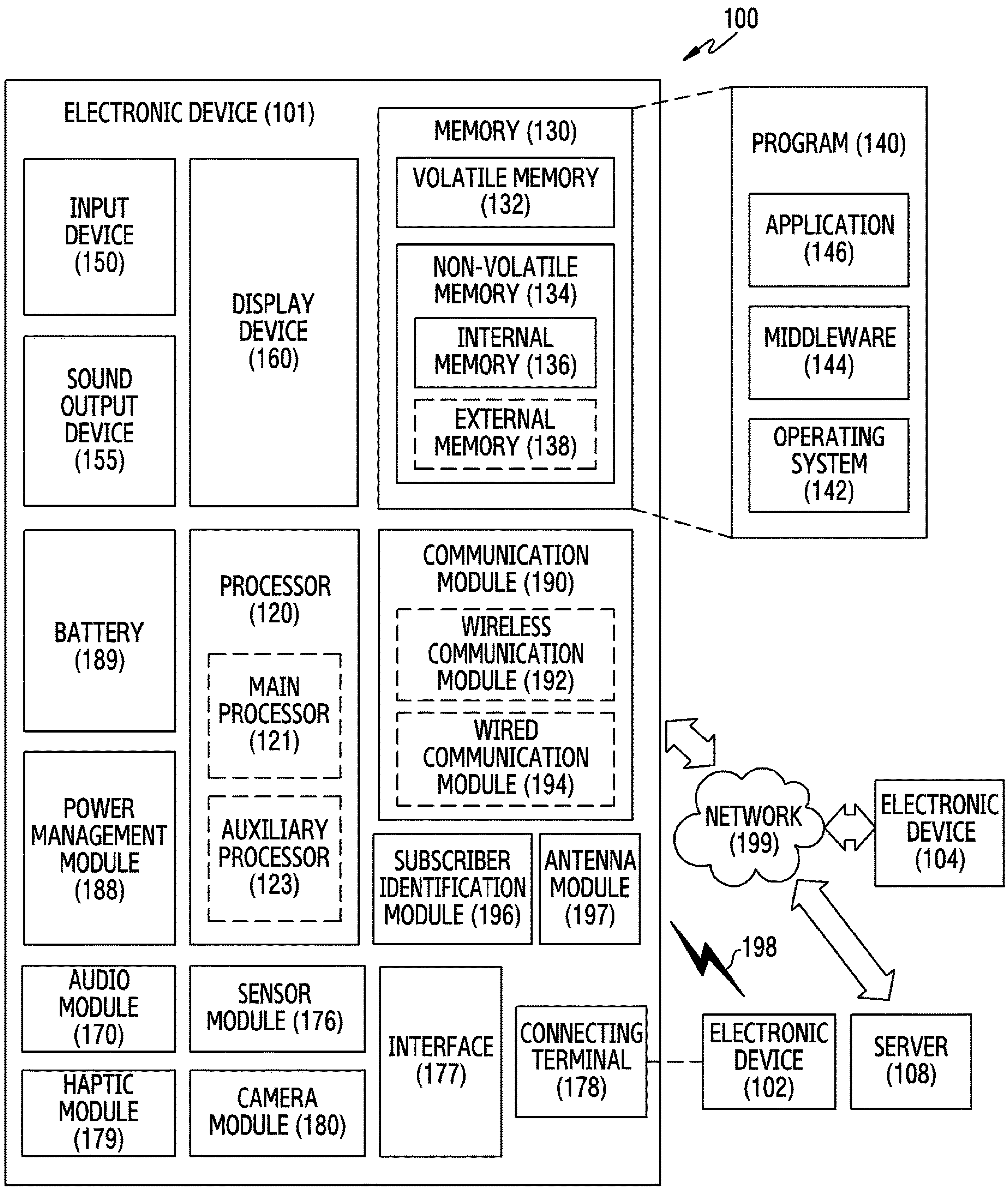

100
ELECTRONIC DEVICE (101)
INPUT DEVICE (150)
SOUND OUTPUT DEVICE (155)
DISPLAY DEVICE (160)
MEMORY (130)
VOLATILE MEMORY (132)
NON-VOLATILE MEMORY (134)
INTERNAL MEMORY (136)
EXTERNAL MEMORY (138)
PROGRAM (140)
APPLICATION (146)
MIDDLEWARE (144)
OPERATING SYSTEM (142)
BATTERY (189)
PROCESSOR (120)
MAIN PROCESSOR (121)
AUXILIARY PROCESSOR (123)
COMMUNICATION MODULE (190)
WIRELESS COMMUNICATION MODULE (192)
WIRED COMMUNICATION MODULE (194)
POWER MANAGEMENT MODULE (188)
SUBSCRIBER IDENTIFICATION MODULE (196)
ANTENNA MODULE (197)
NETWORK (199)
ELECTRONIC DEVICE (104)
198
AUDIO MODULE (170)
SENSOR MODULE (176)
INTERFACE (177)
CONNECTING TERMINAL (178)
ELECTRONIC DEVICE (102)
SERVER (108)
HAPTIC MODULE (179)
CAMERA MODULE (180)

FIG.1

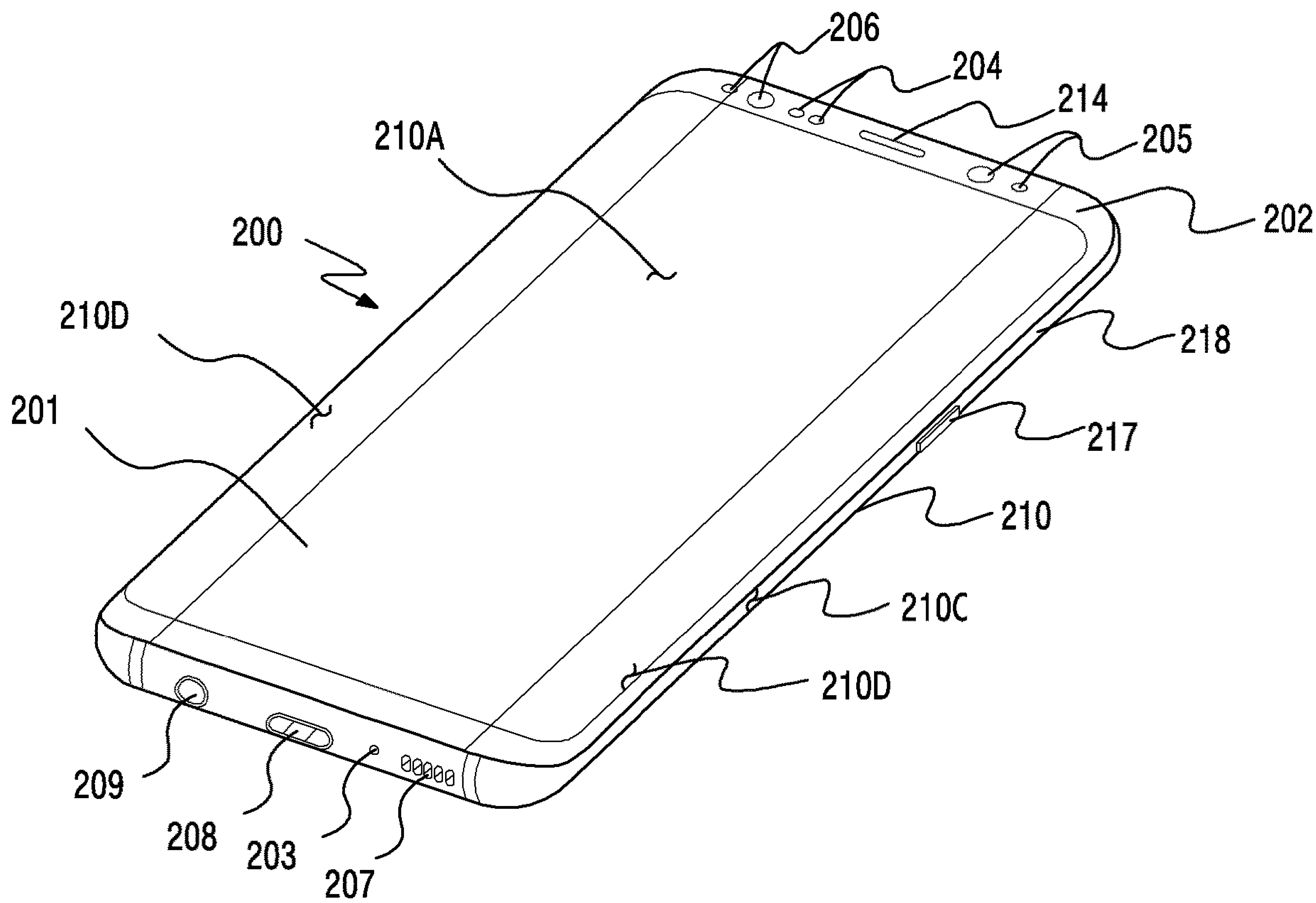

206
204
214
205
202
210A
200
210D
218
201
217
210
210C
210D
209
208
203
207

FIG.2A

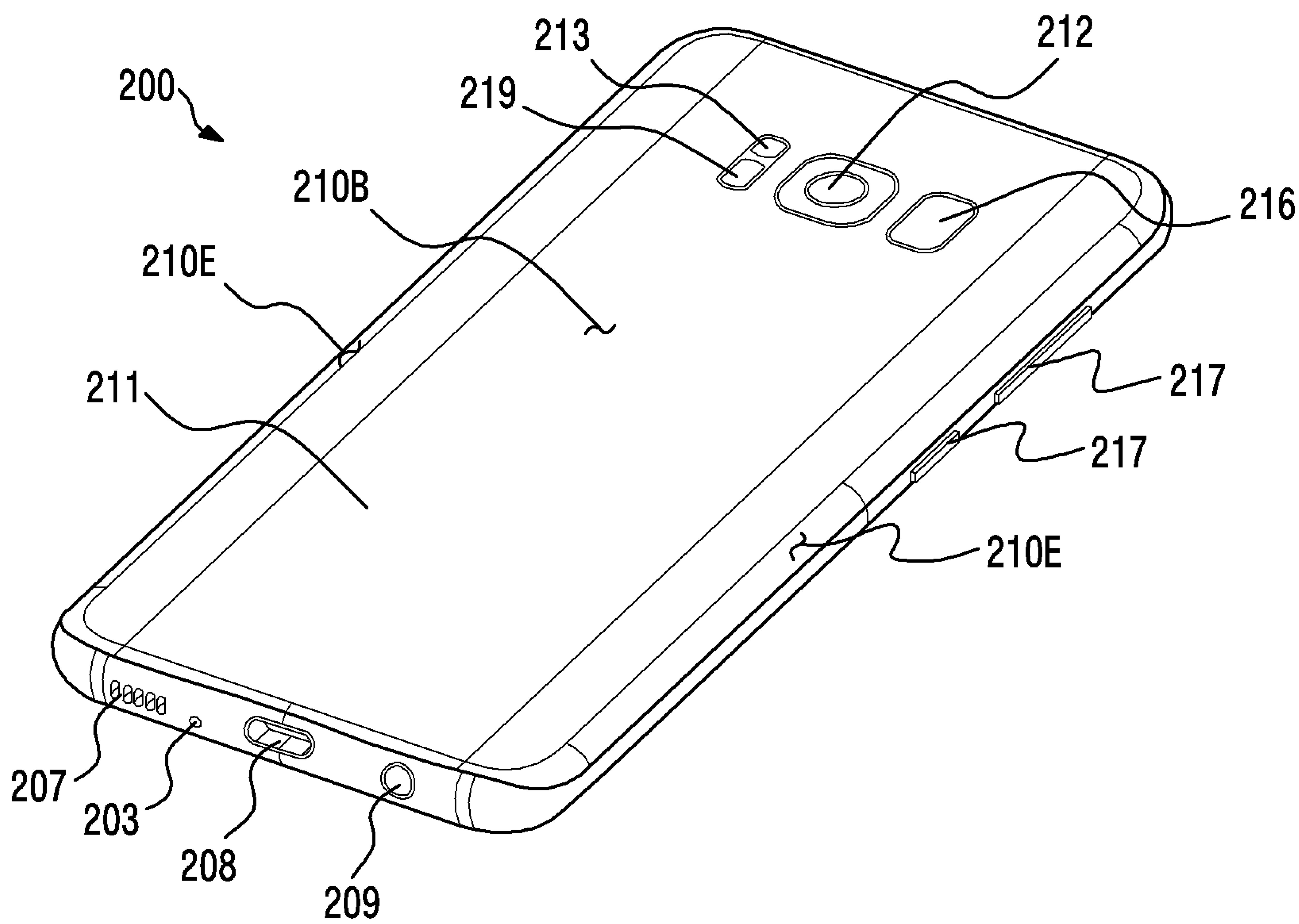


FIG.2B

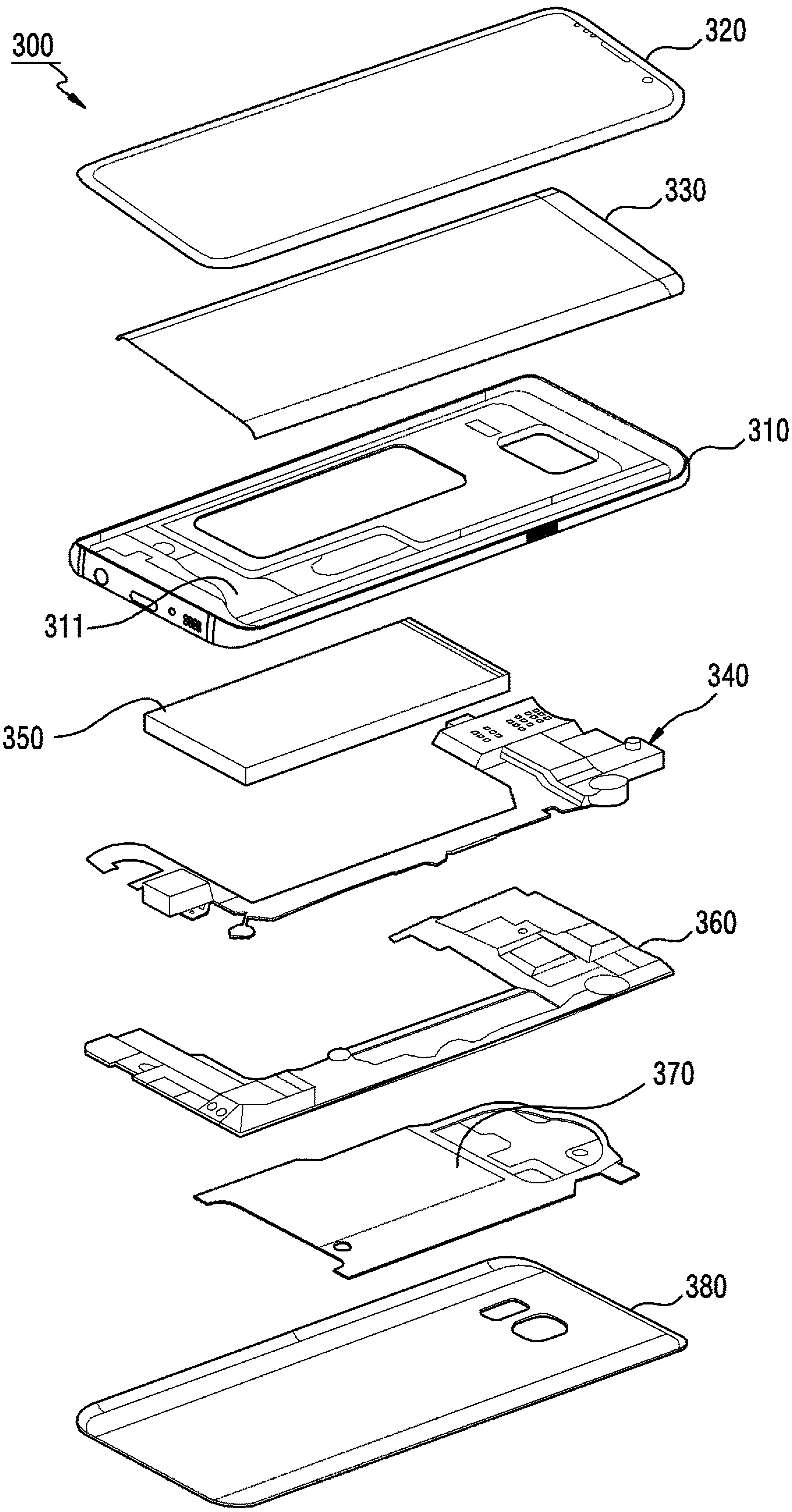


FIG.3

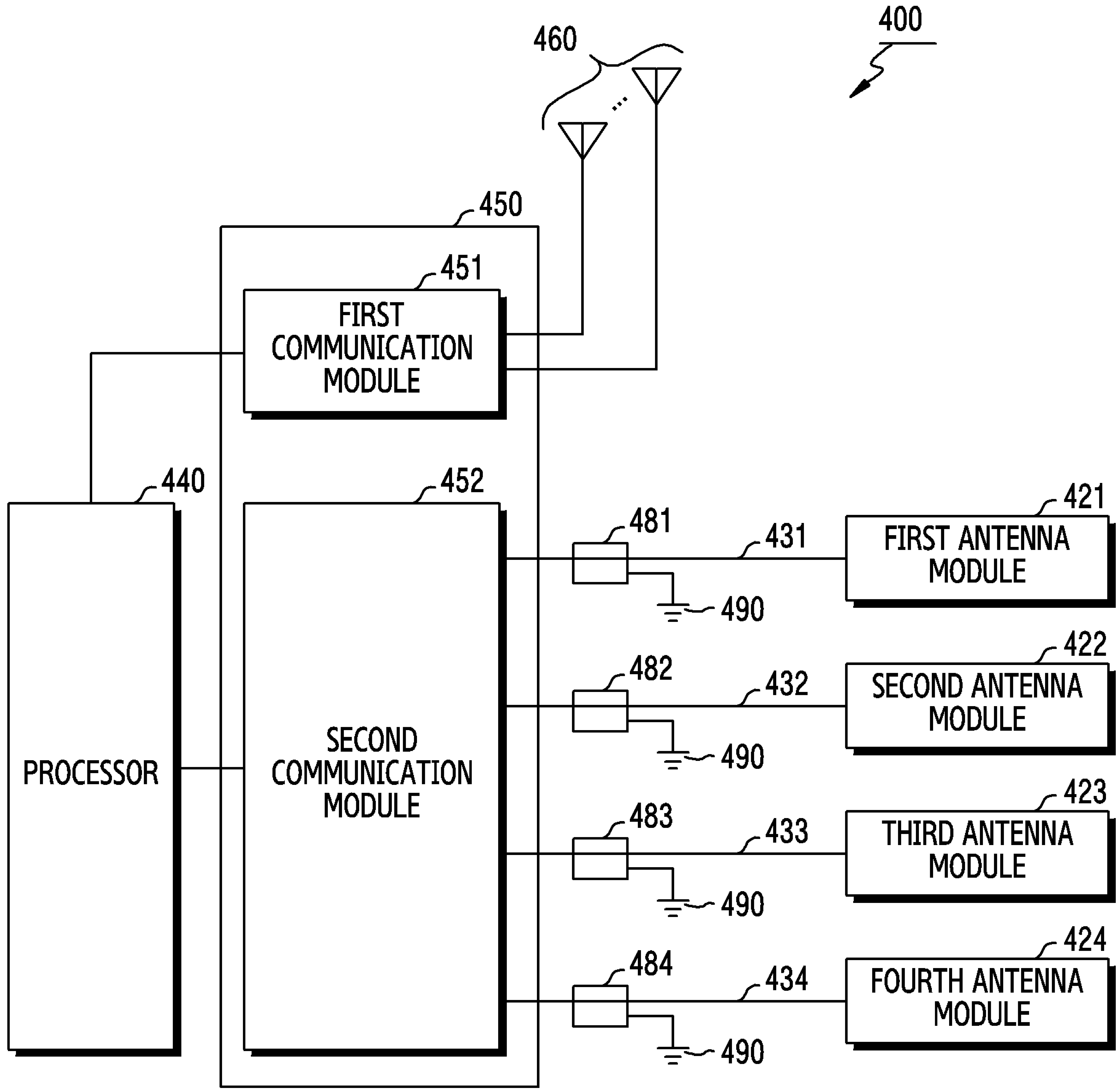

400
460
450
451
FIRST COMMUNICATION MODULE
440
452
PROCESSOR
SECOND COMMUNICATION MODULE
481
431
421
FIRST ANTENNA MODULE
490
482
432
422
SECOND ANTENNA MODULE
490
483
433
423
THIRD ANTENNA MODULE
490
484
434
424
FOURTH ANTENNA MODULE
490

FIG.4

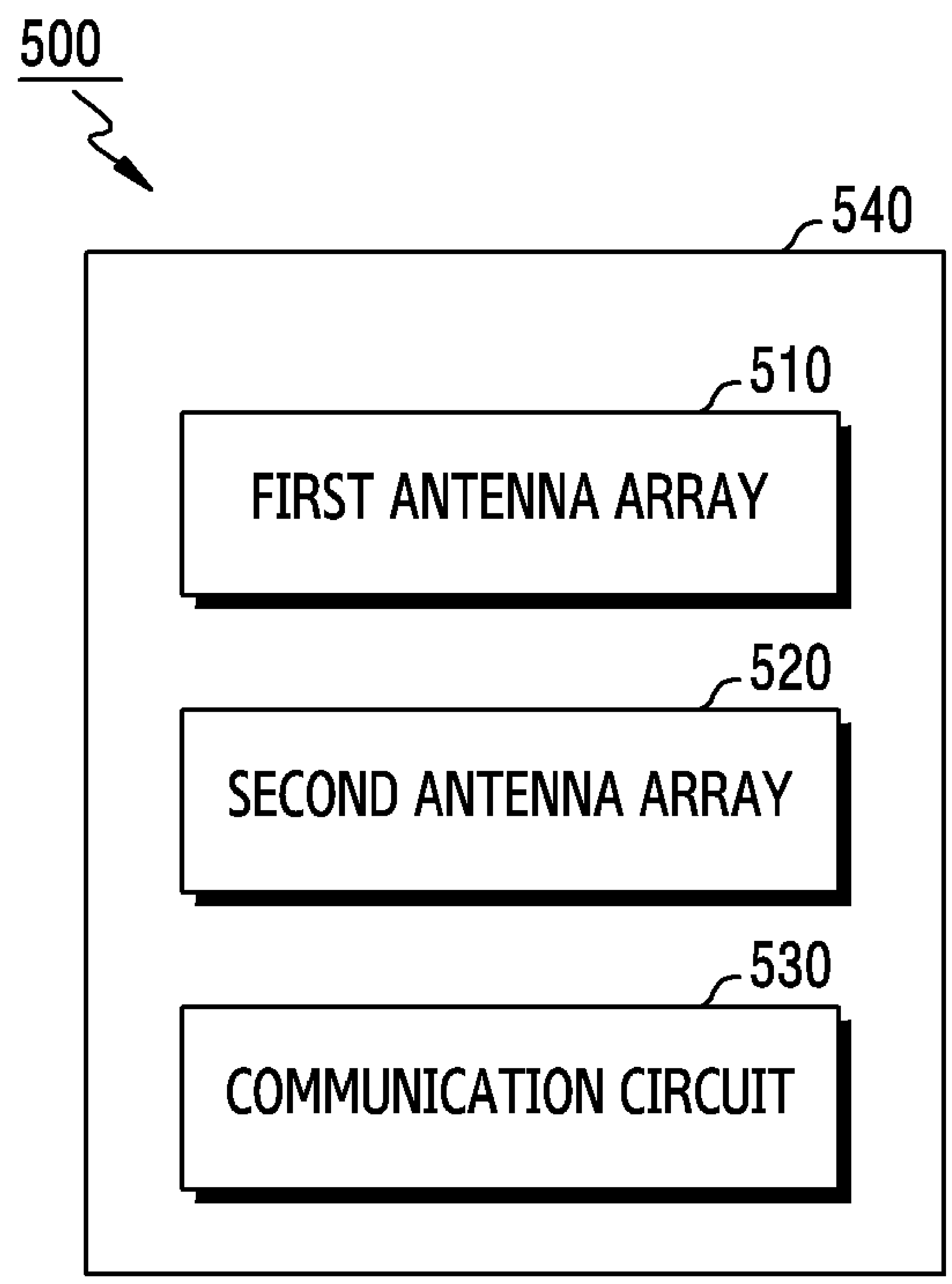

500
540
510
FIRST ANTENNA ARRAY
520
SECOND ANTENNA ARRAY
530
COMMUNICATION CIRCUIT

FIG.5

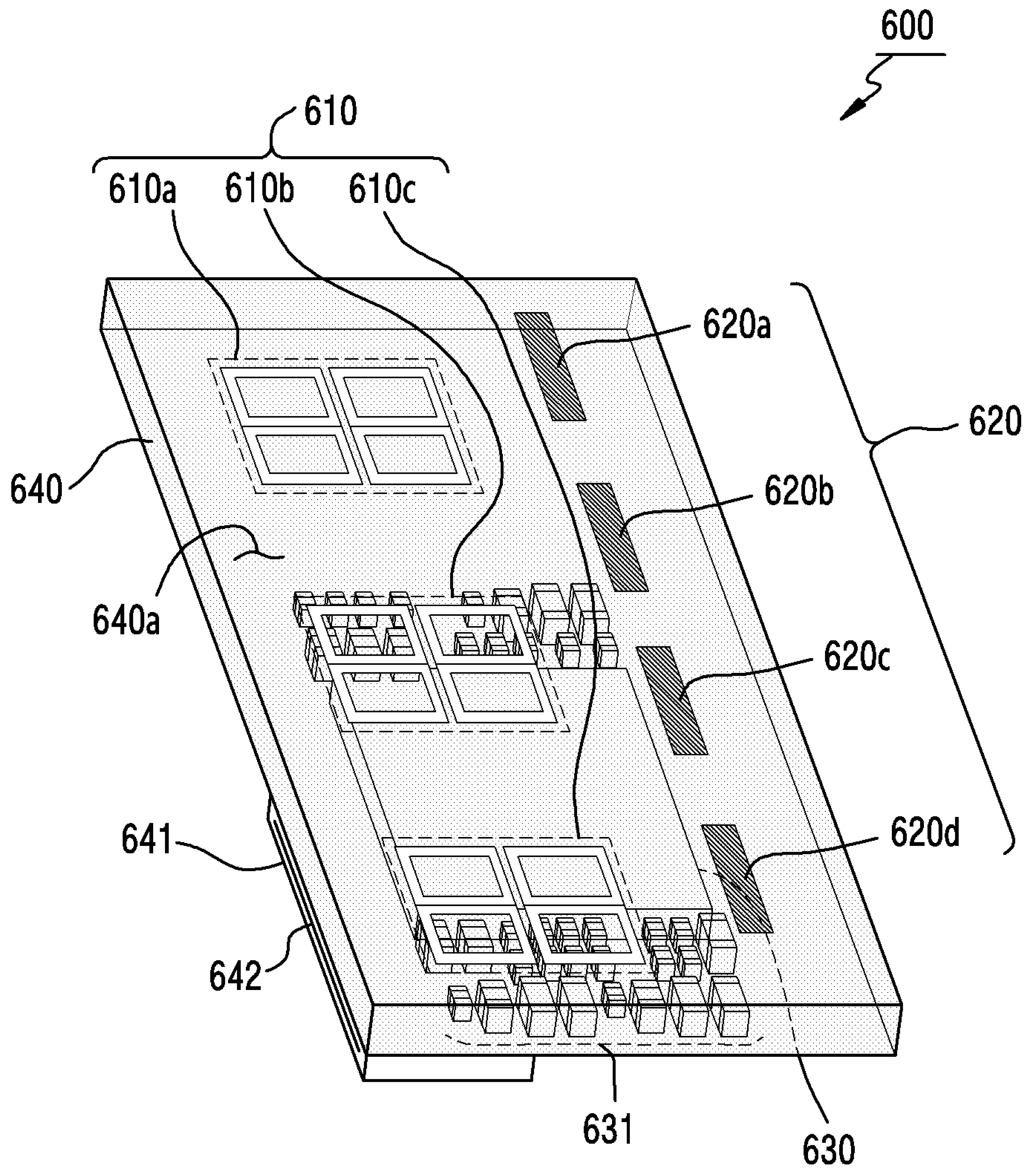
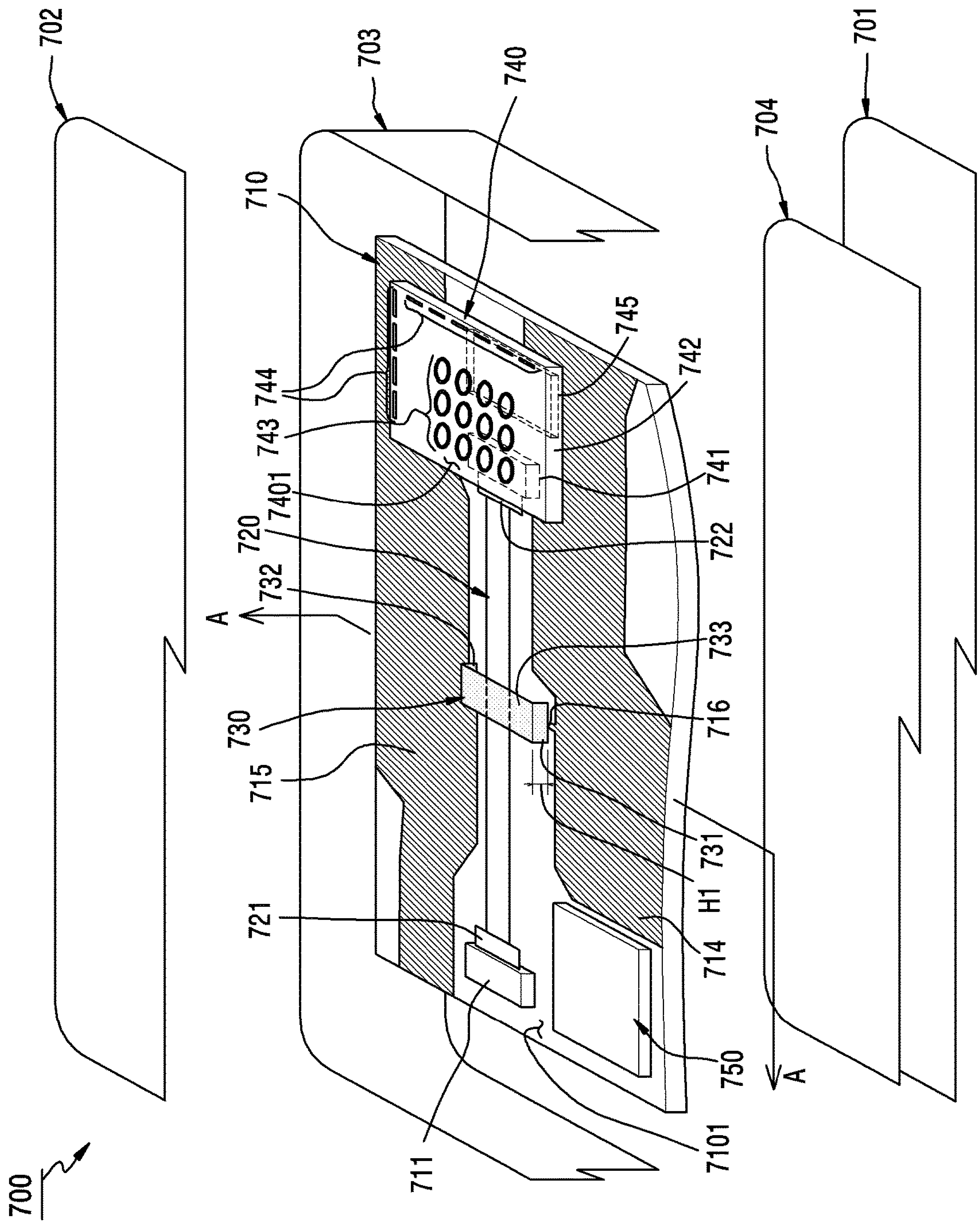

600
610
610a
610b
610c
620a
620
620b
620c
620d
640
640a
641
642
631
630

FIG.6



702
703
740
704
701
710
745
742
744
743
741
7401
722
720
732
A
733
716
730
715
731
H1
721
714
750
A
7101
711
700

FIG.7A

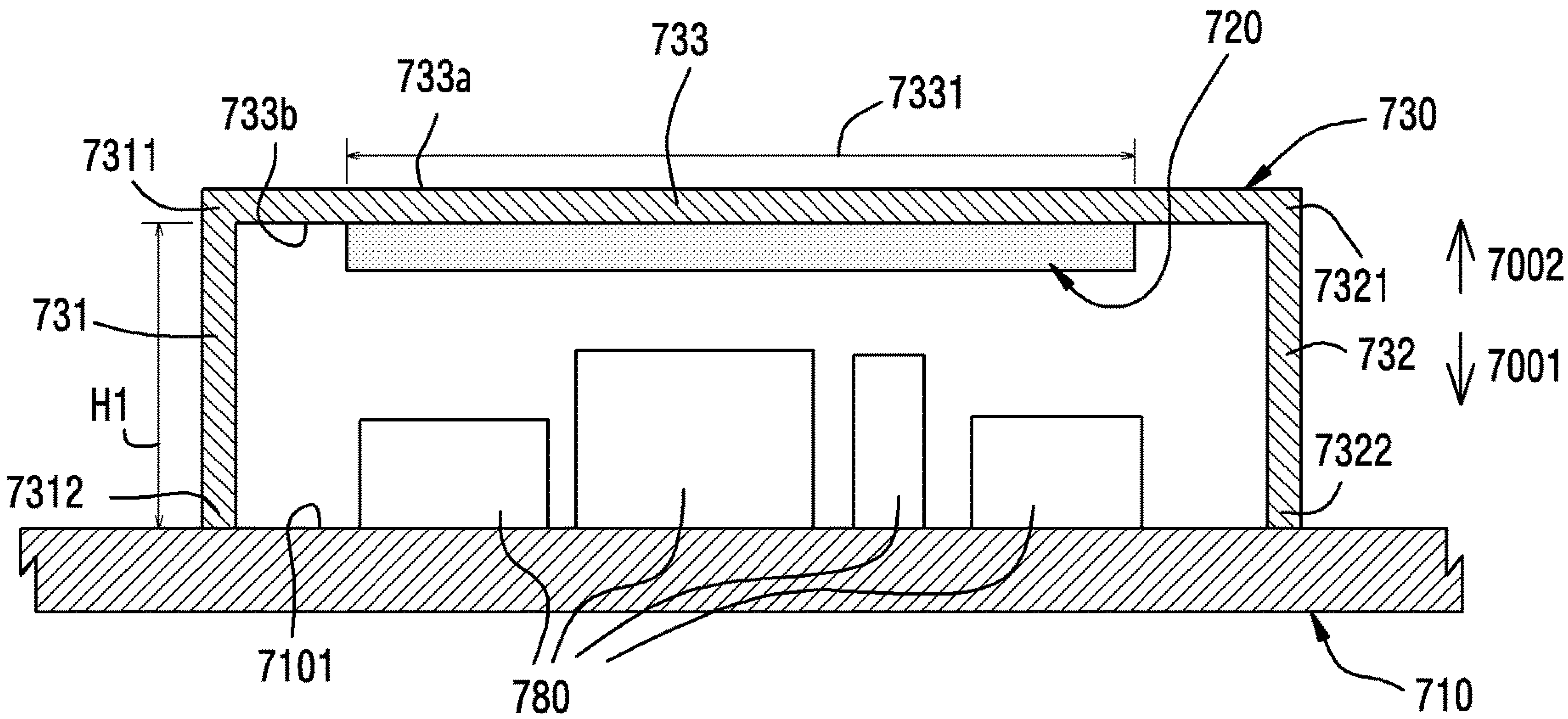

733
733a
7331
720
730
733b
7311
7002
7321
731
732
7001
H1
7322
7312
7101
780
710

FIG.7B

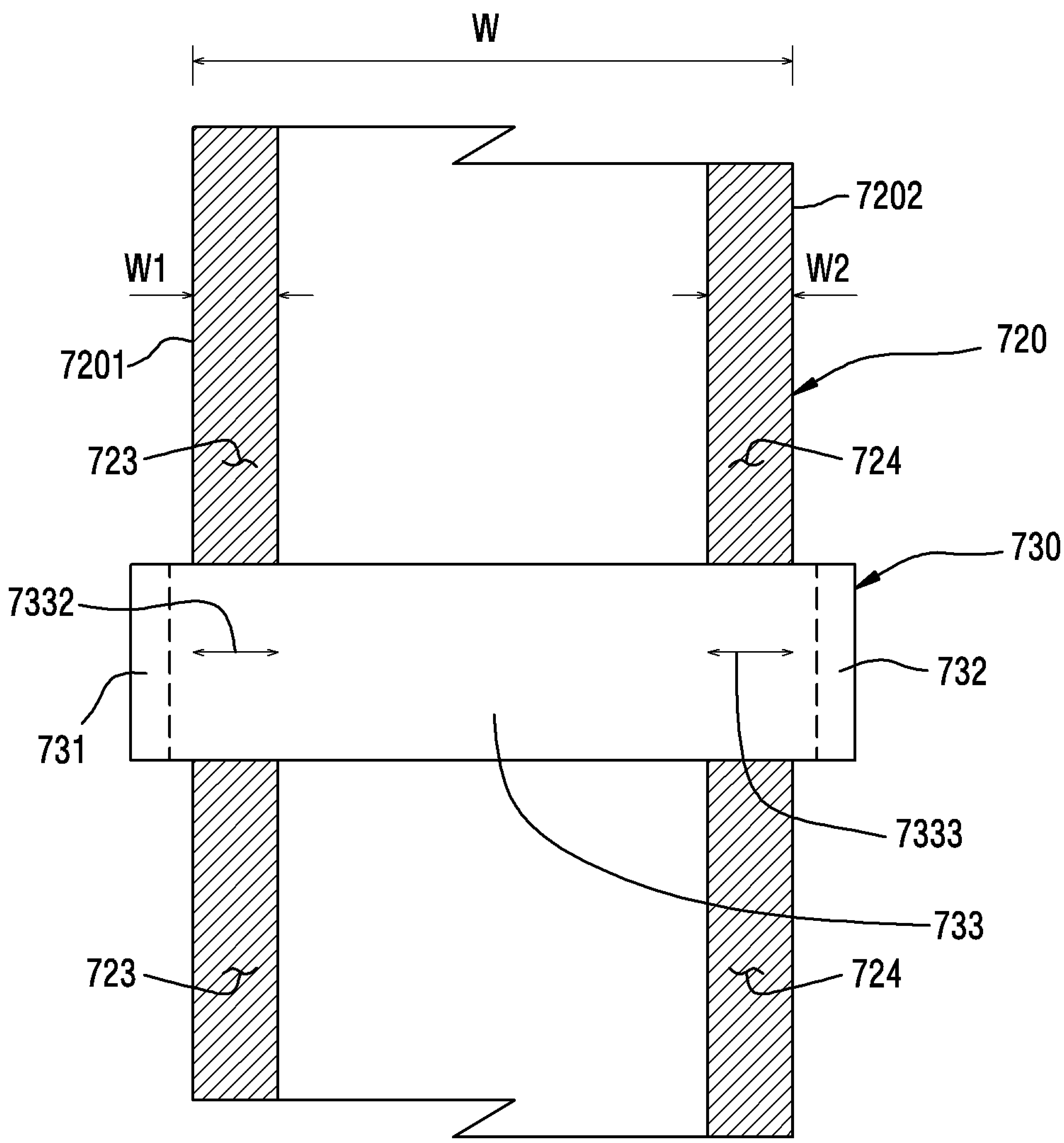


FIG.7C

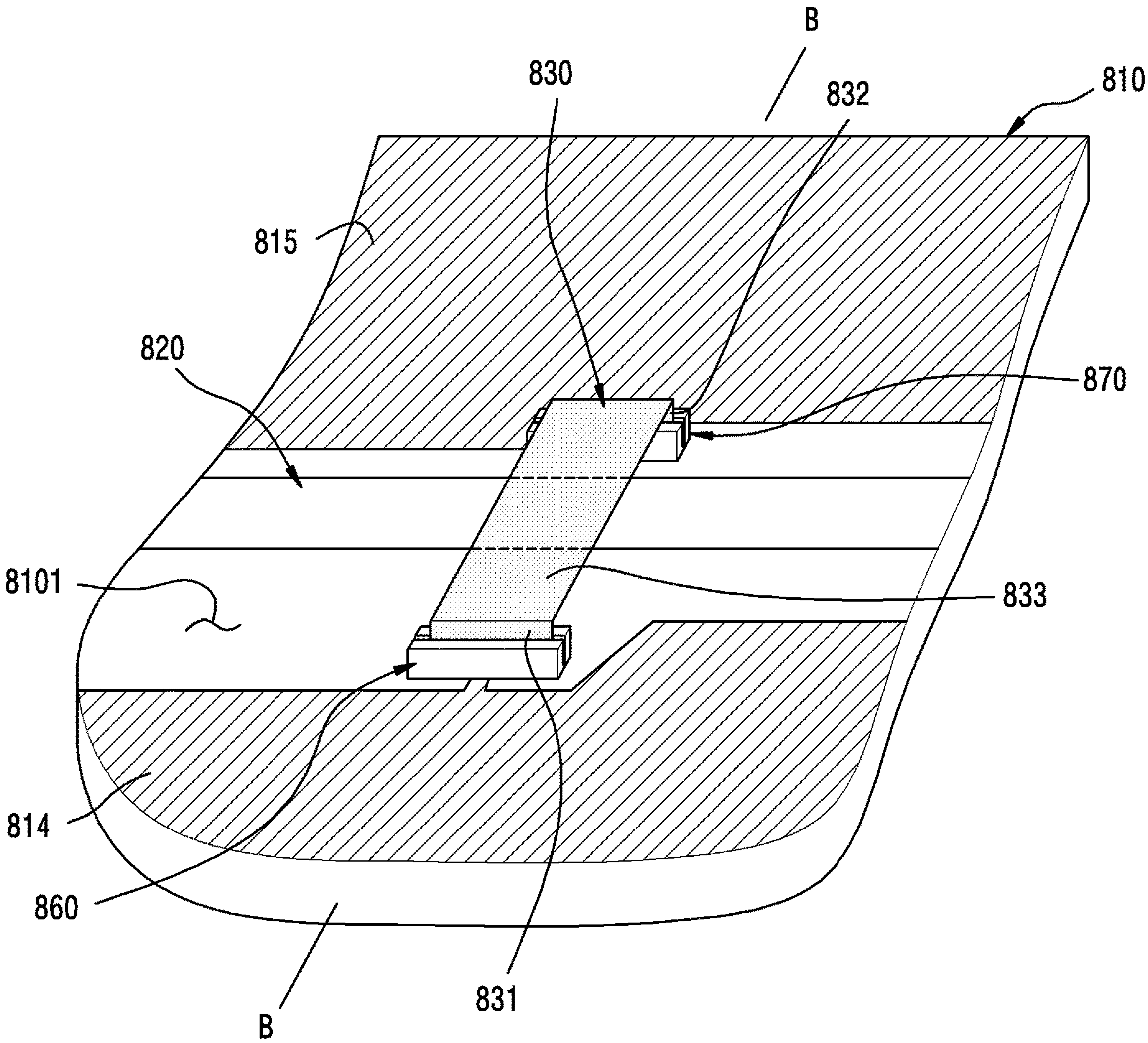


FIG.8A

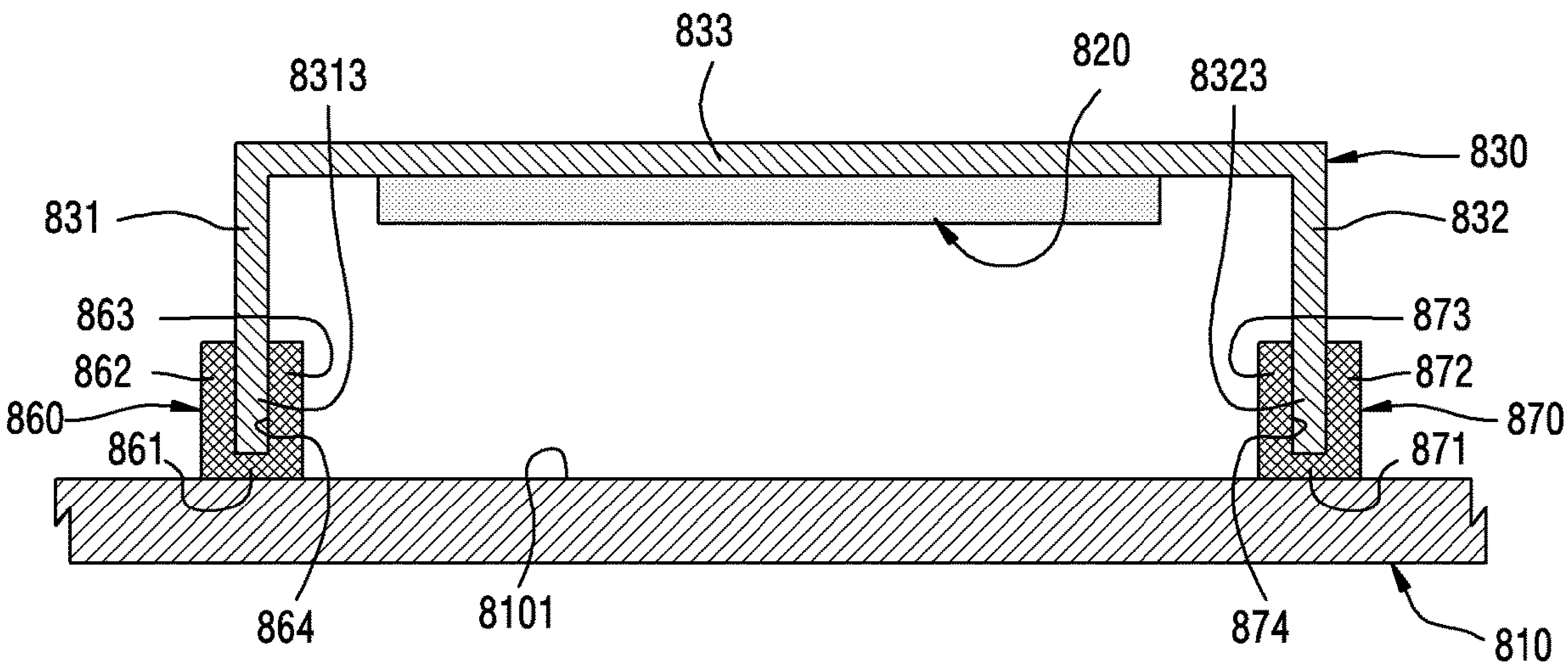

833
820
8313
8323
830
831
832
863
873
862
872
860
870
861
871
864
8101
874
810

FIG.8B

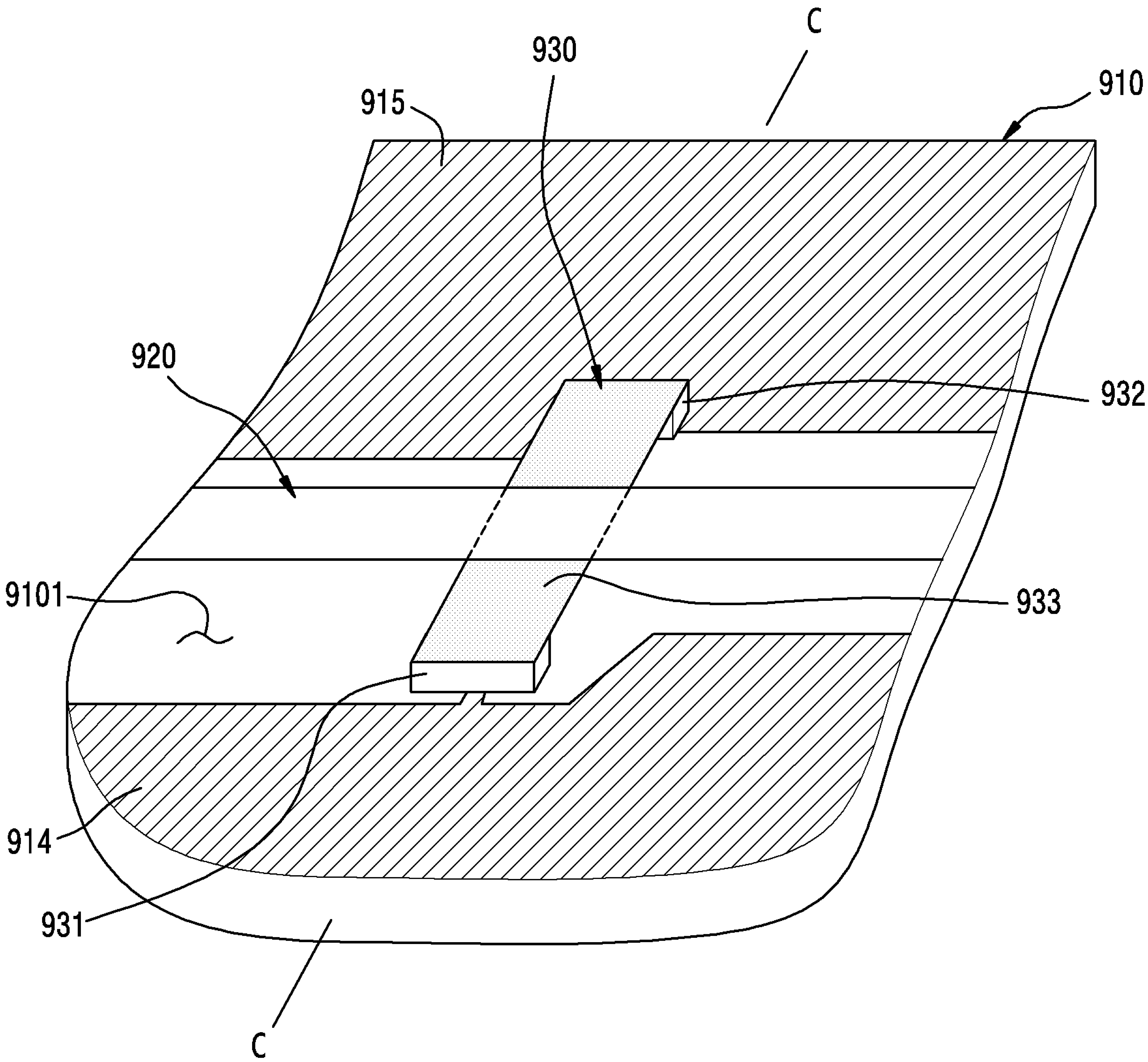


FIG.9A

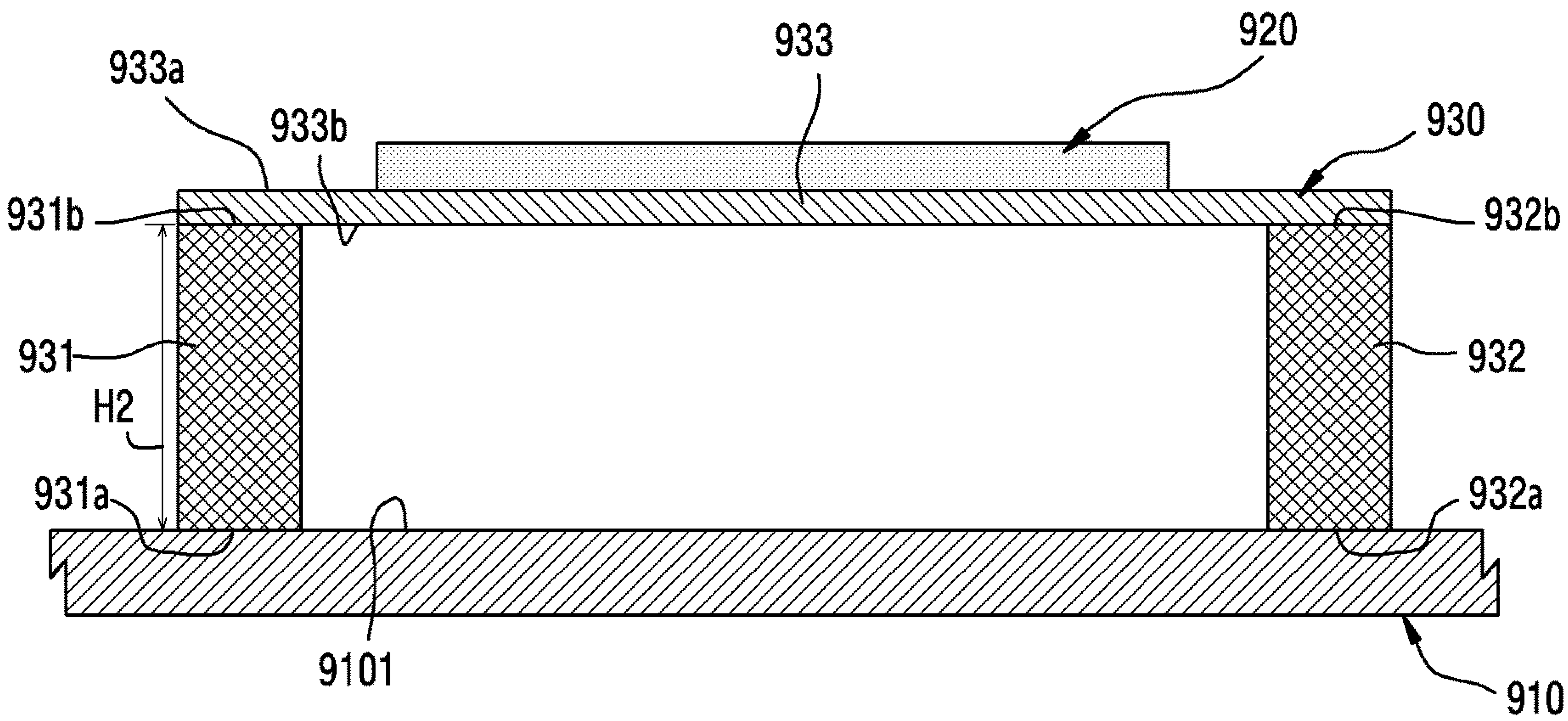


FIG.9B

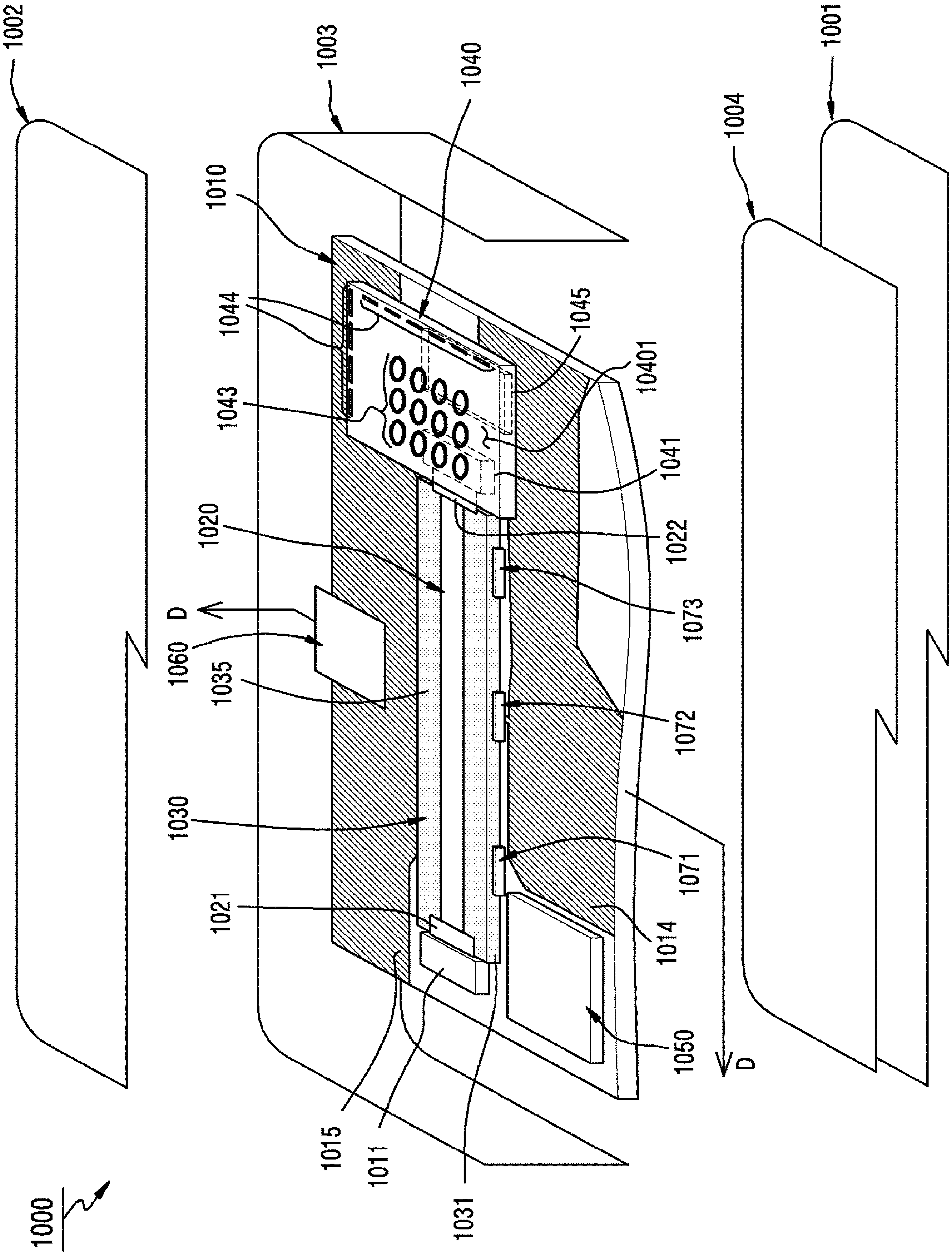

1002
1003
1040
1001
1004
1010
1044
1045
10401
1043
1041
1020
1022
D
1073
1060
1035
1072
1030
1071
1021
1014
1050
D
1015
1011
1031
1000

FIG.10A

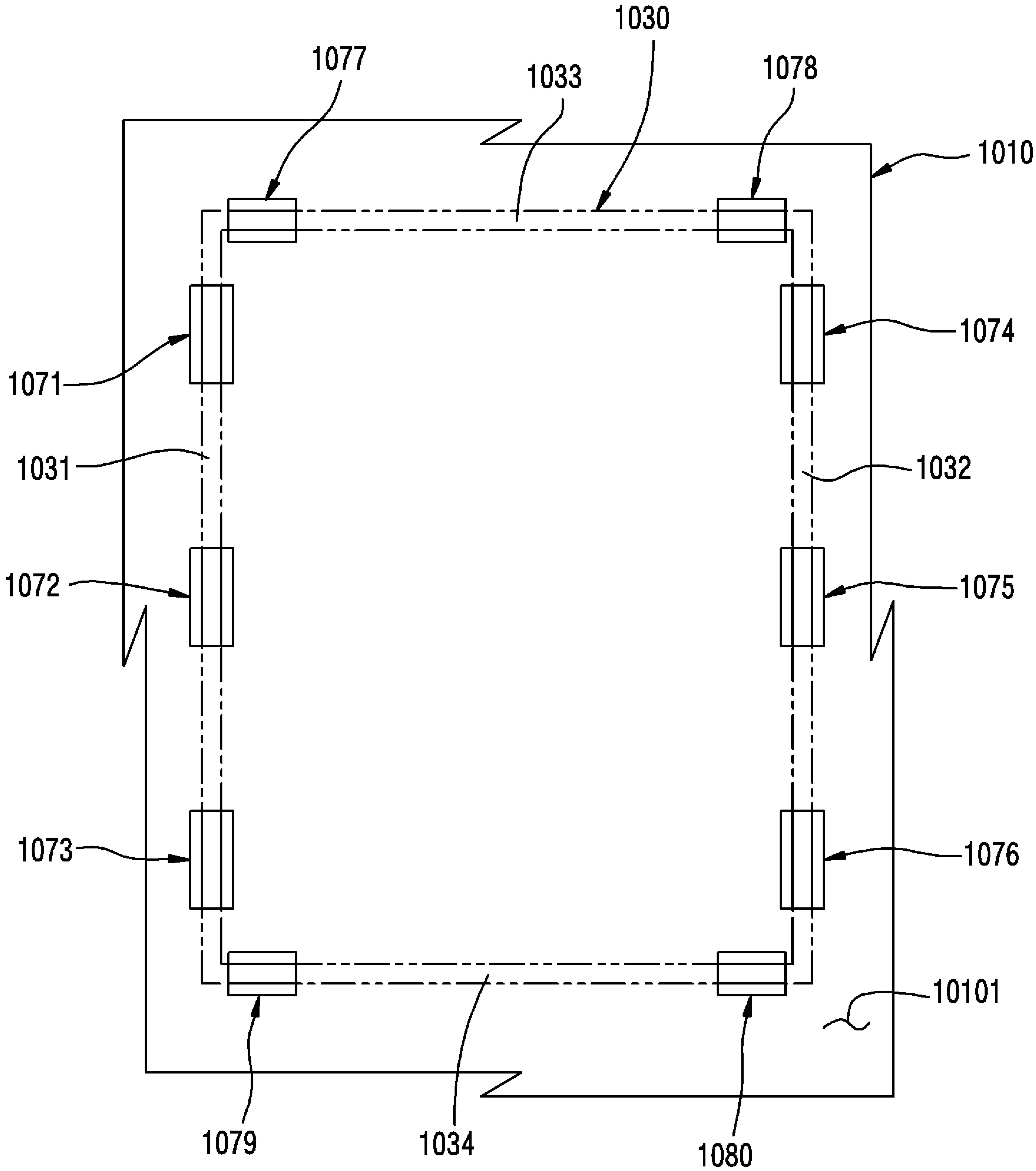

1030
1077
1033
1078
1010
1074
1071
1031
1032
1072
1075
1073
1076
10101
1079
1034
1080

FIG.10B

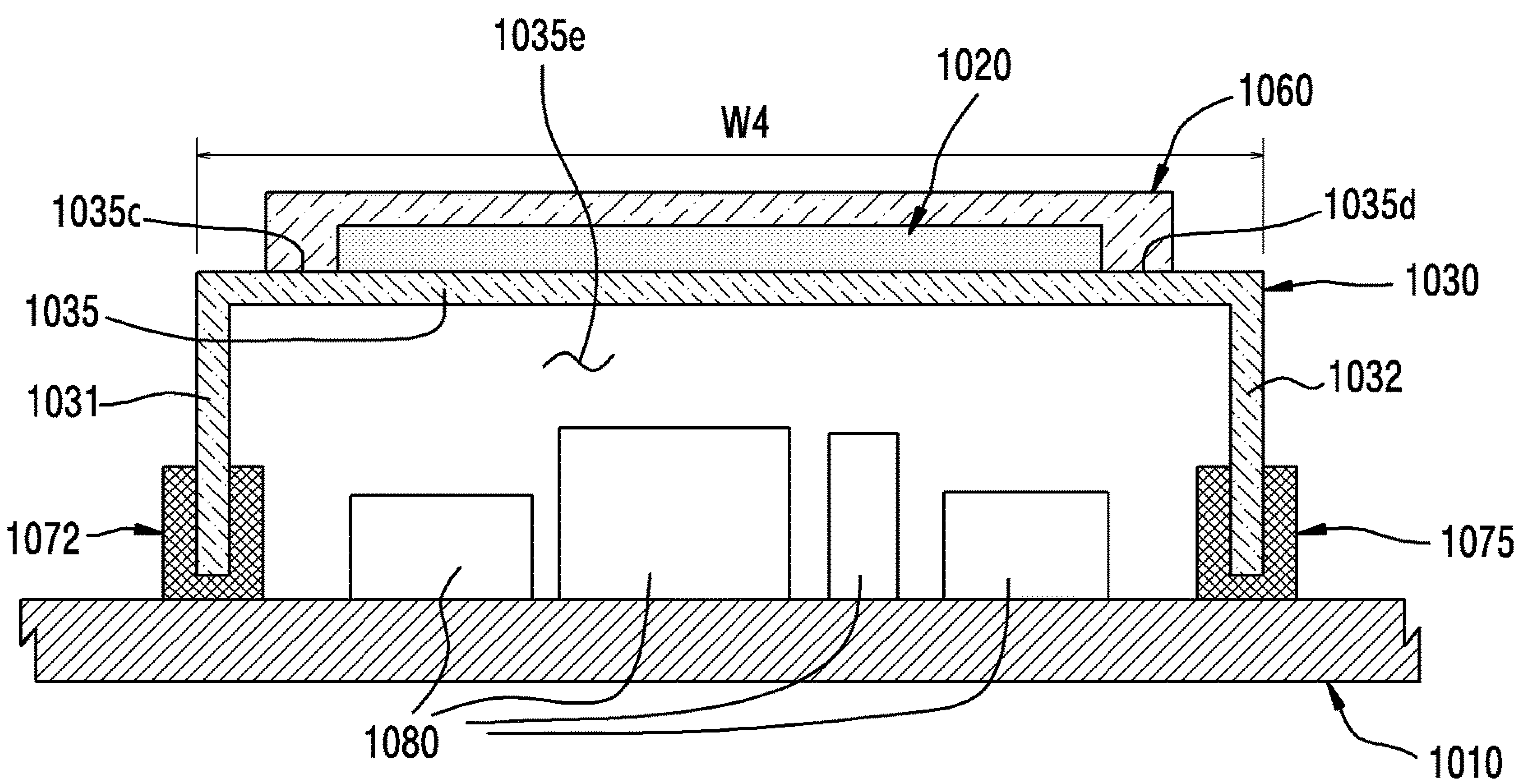

1035e
1020
1060
W4
1035c
1035d
1030
1035
1031
1032
1072
1075
1080
1010

FIG.10C

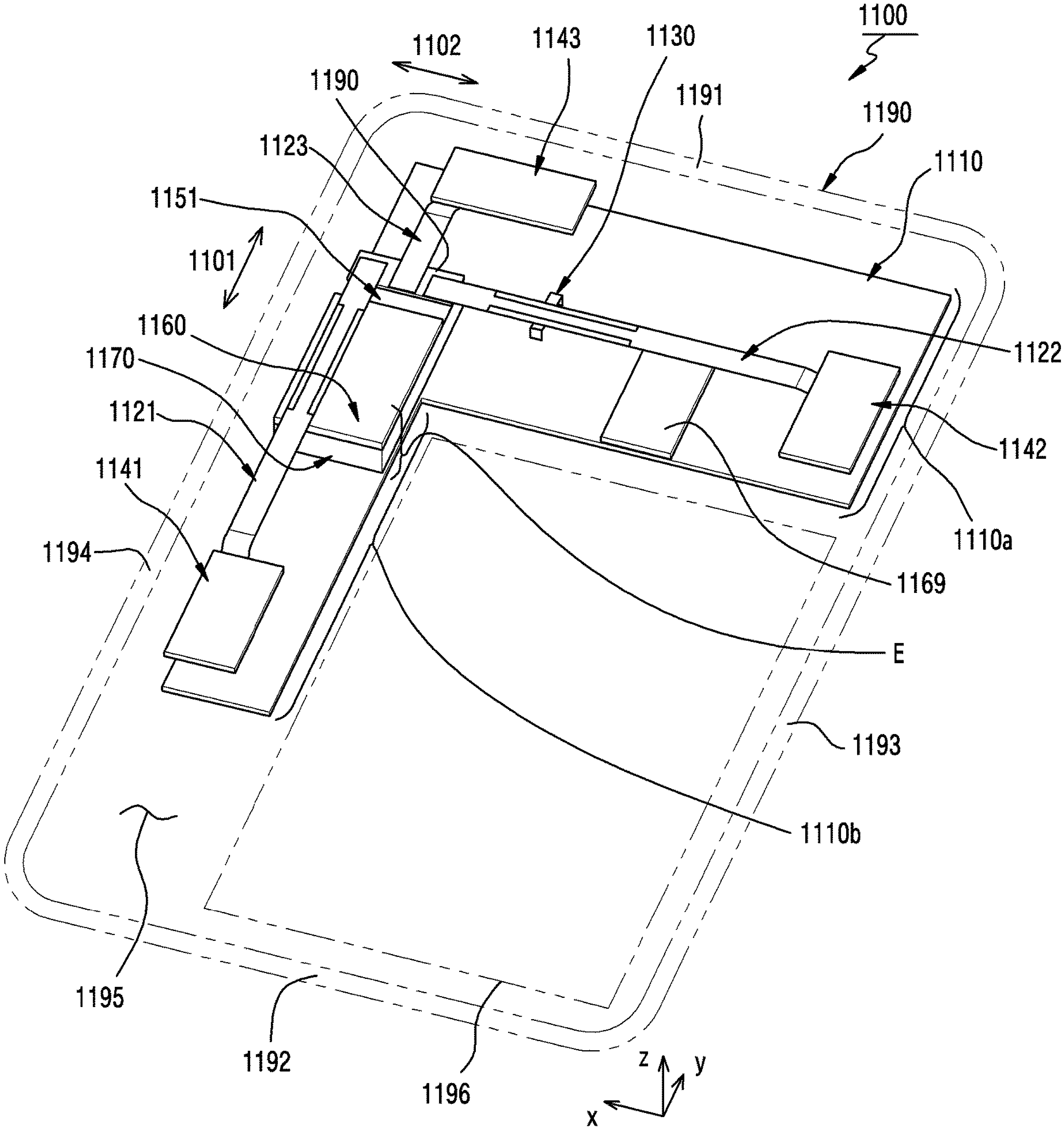

1100
1102
1143
1130
1190
1191
1190
1123
1110
1151
1101
1160
1122
1170
1121
1142
1141
1110a
1194
1169
E
1193
1110b
1195
1192
1196
z
y
x

FIG.11

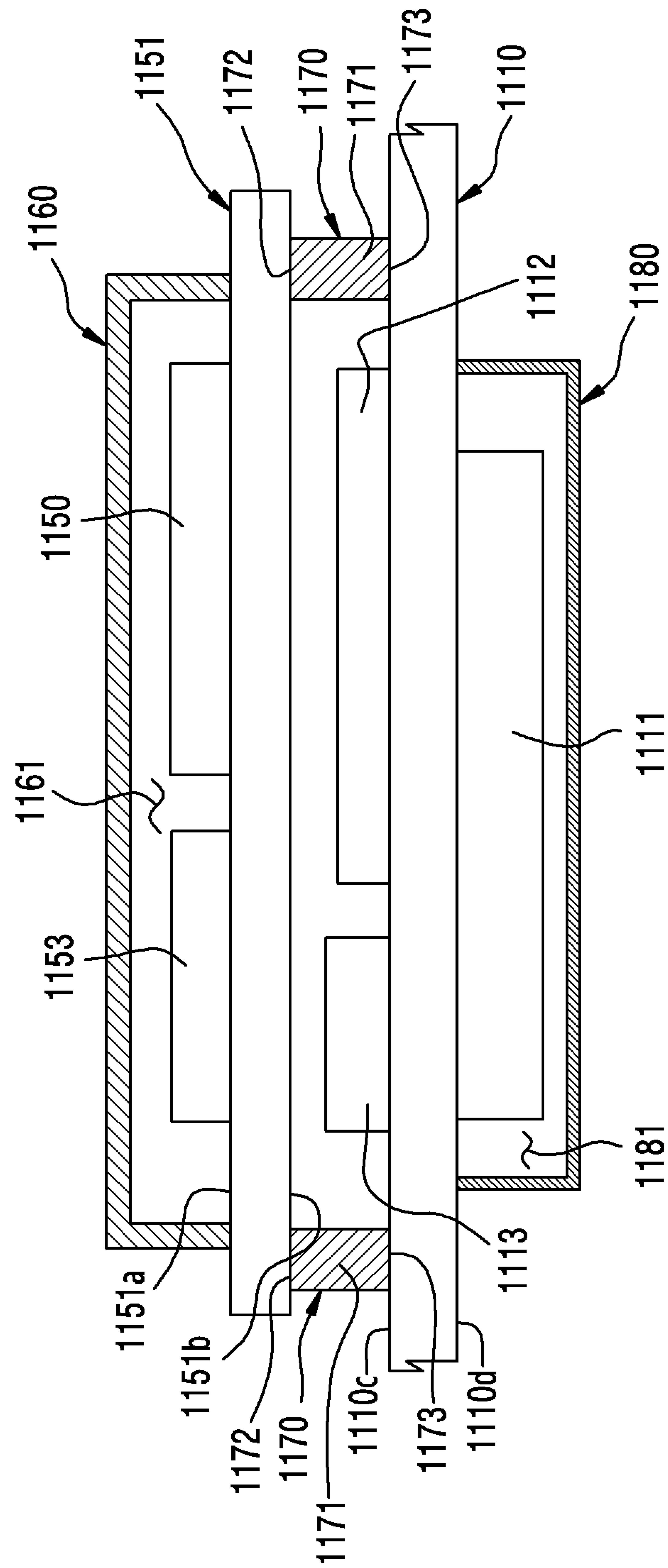

1151
1172
1170
1171
1173
1110
1160
1112
1180
1150
1111
1161
1153
1181
1151a
1151b
1172
1170
1171
1110c
1173
1110d
1113

FIG. 12

ELECTRONIC DEVICE INCLUDING CONDUCTIVE STRUCTURE CONNECTING ELECTRICALLY GROUND LAYER OF FLEXIBLE PRINTED CIRCUIT BOARD AND GROUND LAYER OF PRINTED CIRCUIT BOARD

CROSS REFERENCE TO RELATED APPLICATION

This application is based on and claims priority under 35 U.S.C. § 119 to Korean Patent Application No. 10-2018-0126469, filed on Oct. 23, 2018, in the Korean Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

Field

The disclosure relates to an electronic device including a ground layer of a Flexible Printed Circuit Board (FPCB) and a conductive structure which electrically couples a ground layer of a Printed Circuit Board (PCB).

Description of Related Art

With the development of digital technologies, electronic devices are provided in various forms, such as a smart phone, a tablet Personal Computer (PC), a Personal Digital Assistant (PDA), or the like. The electronic device is also developed such that it is worn by a user to improve portability and user accessibility. With the development of wireless communication technologies, electronic devices (e.g., communication electronic devices) are widely used in everyday life, and thus the use of content increases exponentially. The electronic device may include a member such as a Flexible Printed Circuit Board (FPCB) which provide electrical coupling between elements regarding a wireless communication circuit.

When electromagnetic noise (e.g., electromagnetic wave noise) generated inside an electronic device has effect on a corresponding transmission line (e.g., an FPCB), performance deterioration may occur. For example, wireless communication of a high frequency band may be more sensitive to an influence of the electromagnetic noise of a high frequency band.

SUMMARY

Embodiments of the disclosure may provide an electronic device including a ground layer of an FPCB and a conductive structure which electrically couples a ground layer of a PCB, to reduce Electro Magnetic Interference (EMI) on the FPCB utilized as a transmission line.

According to an example embodiment, an electronic device may include a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or constructed integrally with the second plate, a display viewable through at least part of the first plate, a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer, a Flexible Printed Circuit Board (FPCB) at least partially overlapping the first PCB when viewed from above the first plate, the FPCB including a first end electrically coupled to the first

PCB, a second end, and at least one second ground layer, and a conductive structure comprising a conductive material disposed between the first PCB and the FPCB and electrically coupling the first ground layer and the second ground layer.

According to various embodiments, since a conductive structure disposed between a Flexible Printed Circuit Board (FPCB) and a Printed Circuit Board (PCB) electrically couples a ground layer of the FPCB and a ground layer of the PCB, Electro Magnetic Interference (EMI) on the FPCB is decreased, thereby improving performance thereof. In addition, the conductive structure may be utilized as a support which props the FPCB, thereby providing a robust structure between the FPCB and the PCB.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and/or other aspects, features and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a block diagram illustrating an example electronic device in a network environment according to various embodiments;

FIG. **2**A is a front perspective view illustrating an example mobile electronic device according to an embodiment;

FIG. **2**B is a rear perspective view of the example electronic device of FIG. **2**A;

FIG. **3** is an exploded perspective view illustrating an example electronic device according to an embodiment;

FIG. **4** is a block diagram illustrating an example electronic device including conductive structures for electrically coupling ground layers of Flexible Printed Circuit Boards (FPCBs) and a ground layer of a Printed Circuit Board (PCB) according to an embodiment;

FIG. **5** is a block diagram illustrating an example antenna module according to an embodiment;

FIG. **6** is a perspective view illustrating an example antenna module according to an embodiment;

FIG. **7**A is an exploded perspective view illustrating an example electronic device according to an embodiment;

FIG. **7**B is a cross-sectional view of a section A-A in FIG. **7**A;

FIG. **7**C is a diagram illustrating an example FPCB and an example conductive structure according to an embodiment;

FIG. **8**A is a perspective view illustrating an example first PCB, an example FPCB, and an example conductive structure according to an embodiment;

FIG. **8**B is a cross-sectional view of section B-B in FIG. **8**A;

FIG. **9**A is a perspective view illustrating an example first PCB, an example FPCB, and an example conductive structure according to an embodiment;

FIG. **9**B is a cross-sectional view of section C-C in FIG. **9**A;

FIG. **10**A is an exploded perspective view illustrating an example electronic device including an example conductive structure for electrically coupling a ground layer of an FPCB and a ground layer of a PCB according to an embodiment;

FIG. **10**B is a diagram illustrating an example first PCB and an example conductive structure in the electronic device of FIG. **10**A;

FIG. **10**C is a cross-sectional view of section D-D in FIG. **10**A;

FIG. **11** is a perspective view illustrating an example electronic device including a shield member and a conductive structure for electrically coupling ground layers of an FPCB and a ground layer of a PCB according to an embodiment; and

FIG. **12** is a cross-sectional view of section E in FIG. **11**.

DETAILED DESCRIPTION

FIG. **1** is a block diagram illustrating an electronic device **101** in a network environment **100** according to various embodiments. Referring to FIG. **1**, the electronic device **101** in the network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). According to an embodiment, the electronic device **101** may communicate with the electronic device **104** via the server **108**. According to an embodiment, the electronic device **101** may include a processor **120**, memory **130**, an input device **150**, a sound output device **155**, a display device **160**, an audio module **170**, a sensor module **176**, an interface **177**, a haptic module **179**, a camera module **180**, a power management module **188**, a battery **189**, a communication module **190**, a subscriber identification module (SIM) **196**, or an antenna module **197**. In some embodiments, at least one (e.g., the display device **160** or the camera module **180**) of the components may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. In some embodiments, some of the components may be implemented as single integrated circuitry. For example, the sensor module **176** (e.g., a fingerprint sensor, an iris sensor, or an illuminance sensor) may be implemented as embedded in the display device **160** (e.g., a display).

The processor **120** may execute, for example, software (e.g., a program **140**) to control at least one other component (e.g., a hardware or software component) of the electronic device **101** coupled with the processor **120**, and may perform various data processing or computation. According to an example embodiment, as at least part of the data processing or computation, the processor **120** may load a command or data received from another component (e.g., the sensor module **176** or the communication module **190**) in volatile memory **132**, process the command or the data stored in the volatile memory **132**, and store resulting data in non-volatile memory **134**. According to an embodiment, the processor **120** may include a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), and an auxiliary processor **123** (e.g., a graphics processing unit (GPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor **121**. Additionally or alternatively, the auxiliary processor **123** may be adapted to consume less power than the main processor **121**, or to be specific to a specified function. The auxiliary processor **123** may be implemented as separate from, or as part of the main processor **121**.

The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display device **160**, the sensor module **176**, or the communication module **190**) among the components of the electronic device **101**, instead of the main processor **121** while the main processor **121** is in an inactive (e.g., sleep) state, or together with the main processor **121** while the main processor **121** is in an active state (e.g., executing an application). According to an embodiment, the auxiliary processor **123** (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module **180** or the communication module **190**) functionally related to the auxiliary processor **123**.

The memory **130** may store various data used by at least one component (e.g., the processor **120** or the sensor module **176**) of the electronic device **101**. The various data may include, for example, software (e.g., the program **140**) and input data or output data for a command related thereto. The memory **130** may include the volatile memory **132** or the non-volatile memory **134**.

The program **140** may be stored in the memory **130** as software, and may include, for example, an operating system (OS) **142**, middleware **144**, or an application **146**.

The input device **150** may receive a command or data to be used by another component (e.g., the processor **120**) of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input device **150** may include, for example, a microphone, a mouse, or a keyboard.

The sound output device **155** may output sound signals to the outside of the electronic device **101**. The sound output device **155** may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record, and the receiver may be used for an incoming call. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

The display device **160** may visually provide information to the outside (e.g., a user) of the electronic device **101**. The display device **160** may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the displays, hologram device, and projector. According to an embodiment, the display device **160** may include touch circuitry adapted to detect a touch, or sensor circuitry (e.g., a pressure sensor) adapted to measure the intensity of force incurred by the touch.

The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module **170** may obtain the sound via the input device **150**, or output the sound via the sound output device **155** or a headphone of an external electronic device (e.g., an electronic device **102**) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.

The sensor module **176** may detect an operational state (e.g., power or temperature) of the electronic device **101** or an environmental state (e.g., a state of a user) external to the electronic device **101**, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module **176** may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

The interface **177** may support one or more specified protocols to be used for the electronic device **101** to be coupled with the external electronic device (e.g., the electronic device **102**) directly (e.g., wiredly) or wirelessly. According to an embodiment, the interface **177** may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.

A connecting terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device (e.g., the electronic device **102**). According to an embodiment, the connecting terminal **178** may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector),

The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module **179** may include, for example, a motor, a piezoelectric element, or an electric stimulator.

The camera module **180** may capture a still image or moving images. According to an embodiment, the camera module **180** may include one or more lenses, image sensors, image signal processors, or flashes.

The power management module **188** may manage power supplied to the electronic device **101**. According to an example embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

The battery **189** may supply power to at least one component of the electronic device **101**. According to an embodiment, the battery **189** may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.

The communication module **190** may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device **101** and the external electronic device (e.g., the electronic device **102**, the electronic device **104**, or the server **108**) and performing communication via the established communication channel. The communication module **190** may include one or more communication processors that are operable independently from the processor **120** (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module **190** may include a wireless communication module **192** (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module **194** (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network **198** (e.g., a short-range communication network, such as Bluetoot™, wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network **199** (e.g., a long-range communication network, such as a cellular network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module **192** may identify and authenticate the electronic device **101** in a communication network, such as the first network **198** or the second network **199**, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module **196**.

The antenna module **197** may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device **101**. According to an embodiment, the antenna module **197** may include one or more antennas, and, therefrom, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network **198** or the second network **199**, may be selected, for example, by the communication module **190** (e.g., the wireless communication module **192**). The signal or the power may then be transmitted or received between the communication module **190** and the external electronic device via the selected at least one antenna.

At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

According to an embodiment, commands or data may be transmitted or received between the electronic device **101** and the external electronic device **104** via the server **108** coupled with the second network **199**. Each of the electronic devices **102** and **104** may be a device of a same type as, or a different type, from the electronic device **101**. According to an embodiment, all or some of operations to be executed at the electronic device **101** may be executed at one or more of the external electronic devices **102**, **104**, or **108**. For example, if the electronic device **101** should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device **101**, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device **101**. The electronic device **101** may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, or client-server computing technology may be used, for example.

The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, and without limitation, a portable communication device (e.g., a smart phone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.

It should be appreciated that various example embodiments of the present disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as "A or B," "at least one of A and B," "at least one of A or B," "A, B, or C," "at least one of A, B, and C," and "at least one of A, B, or C," may include all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as "1st" and "2nd," or "first" and "second" may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term "operatively" or "communicatively", as "coupled with," "coupled to," "connected with," or "connected to" another element (e.g., a second element), the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.

As used herein, the term "module" may include a unit implemented in hardware, software, or firmware, or any combination thereof and may interchangeably be used with other terms, for example, "logic," "logic block," "part," or "circuitry". A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium (e.g., internal memory **136** or external memory **138**) that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it, with or without using one or more other components under the control of the processor. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the "non-transitory" storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., Play Store), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities. According to various embodiments, one or more of the above-described components may be omitted, or one or more other components may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, according to various embodiments, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

FIG. **2**A is a front perspective view illustrating an example mobile electronic device according to an embodiment. FIG. **2**B is a rear perspective view of the electronic device of FIG. **2**A. FIG. **3** is an exploded perspective view of an example electronic device according to an embodiment.

Referring to FIG. **2**A and FIG. **2**B, an electronic device **200** according to an embodiment may include a housing **210** including a first face (or a front face) **210**A, a second face (or a rear face) **210**B, and a side face **210**C surrounding a space between the first face **210**A and the second face **210**B. In another embodiment (not shown), the housing may refer to a structure which includes part of the first face **210**A, second face **210**B, and third face **210**C of FIG. **2**A. According to an embodiment, the first face **210**A may include a front plate **202** (e.g., a polymer plate or a glass plate having various coating layers) which is at least partially transparent. The second face **210**B may include a rear plate **211** which is substantially opaque. For example, the rear plate **211** may include coated or colored glass, ceramic, polymer, metallic materials (e.g. aluminum, stainless steel (STS), or magnesium) or a combination of at least two of the these materials. The side face **210**C may include a side bezel structure (or a side member) **218** joined with the front plate **202** and the rear plate **211** and including metal and/or polymer. In some embodiments, the rear plate **211** and the side bezel structure **218** may be constructed integrally and may include the same material (e.g., a metallic material such as aluminum).

In the illustrated embodiment, the front plate **202** may include two first regions **210**D seamlessly extended by being bent from the first face **210**A toward the rear plate **211** at both ends of a long edge of the front plate **202**. In the illustrated embodiment (see FIG. **2**B), the rear plate **211** may include two second regions **210**E seamlessly extended by being bent from the second face **210**B toward the front plate **202** at both ends of a long edge. In some embodiments, the front plate **202** (or the rear plate **211**) may include only one of the first regions **210**D (or the second regions **210**E). In another embodiment, part of the first regions **210**D or the second regions **210**E may not be included. In the above embodiments, in a side view of the electronic device **200**, the side bezel structure **218** may have a first thickness (or width) at a side in which the first regions **210**D or the second regions **210**E is not included, and may have a second thickness thinner than the first thickness at a side in which the first regions **210**E or the second regions **210**E is included.

According to an embodiment, the electronic device **200** may include at least one or more of a display **201**, audio modules **203**, **207**, and **214**, sensor modules **204**, **216**, and **219**, camera modules **205**, **212**, and **213**, a key input device **217**, a light emitting element **206**, and connector holes **208** and **209**. In some embodiments, the electronic device **200** may omit at least one of components (e.g., the key input device **217** or the light emitting element **206**), or other components may be additionally included.

The display **201** may be exposed through, for example, some portions of the front plate **202**. In some embodiments, at least part of the display **201** may be exposed through the first face **210**A and the front plate **202** including the first regions **210**E of the side face **210**C. In some embodiments, a corner of the display **201** may be include substantially the same as an outer boundary adjacent to the front plate **202**. In another embodiment (not shown), in order to expand an area in which the display **201** is exposed, the display **210** and the front plate **202** may have substantially the same interval between outer boundaries thereof.

In another embodiment (not shown), a portion of a screen display region of the display **201** may have a recess or opening, and may include at least one or more of the audio module **214**, sensor module **204**, camera module **205**, and light emitting element **206** which are aligned with the recess or the opening may be included. In another embodiment (not shown), at least one of the audio module **214**, the sensor module **204**, the camera module **205**, the fingerprint sensor **216**, and the light emitting element **206** may be included in a rear face of the screen display region of the display **201**. In another embodiment (not shown), the display **201** may be disposed adjacent to or joined with a touch sensing circuit, a pressure sensor capable of measuring touch strength (pressure), and/or a digitizer for detecting a magnetic-type stylus pen. In some embodiments, at least part of the sensor modules **204** and **219** and/or at least part of the key input device **217** may be disposed to the first regions **210**D and/or the second regions **210**E.

The audio modules **203**, **207**, and **214** may include the microphone hole **203** or the speaker holes **207** and **214**. A microphone for acquiring external sound may be disposed inside the microphone hole **203**. In some embodiments, a plurality of microphones may be disposed to detect a direction of the sound. The speaker holes **207** and **214** may include the external speaker hole **207** and the receiver hole **214** for a call. In some embodiments, the speaker holes **207** and **214** and the microphone hole **203** may be implemented as one hole, or a speaker (e.g., a Piezo speaker) may be included without the speaker holes **207** and **214**.

The sensor modules **204**, **216**, and **219** may generate an electrical signal or data value corresponding to an internal operational state of the electronic device **200** or an external environmental state. The sensor modules **204**, **216**, and **219** may include, for example, the first sensor module **204** (e.g., a proximity sensor) and/or second sensor module (not shown) (e.g., a fingerprint sensor) disposed to the first face **210**A of the housing **210**, and/or the third sensor module **219** (e.g., a Heart Rate Monitoring (HRM) sensor) disposed to the second face **210**B of the housing **210** and/or the fourth sensor module **216** (e.g., a fingerprint sensor). The fingerprint sensor may be disposed not only to the first face **210**A (e.g., the display **201**) but also the second face **210**B of the housing **210**. The electronic device **200** may further include at least one of senor modules (not shown), for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a color sensor, an Infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, and an illuminance sensor.

According to an embodiment, the camera modules **205**, **212**, and **213** may include the first camera module **205** disposed to the first face **210**A of the electronic device **200**, the second camera module **212** disposed to the second face **210**B, and/or the flash **213**. The camera module **205** and **212** may include one or more lenses, an image sensor, and/or an image signal processor. The flash **213** may include, for example, a Light Emitting Diode (LED) or a xenon lamp. In some embodiments, two or more lenses (infrared cameras, wide angle and telephoto lenses) and image sensors may be disposed to one face of the electronic device **200**.

The key input device **217** may be disposed to the side face **210**C of the housing **210**. In another embodiment, the electronic device **200** may not include the entirety or part of the key input device **217**. The key input device **217**, which is not included, may be implemented on a display **201** in a different form such as a soft key or the like. In some embodiments, the key input device may include the sensor module **216** disposed to the second face **210**B of the housing **210**.

The light emitting element **206** may be disposed, for example, to the first face **210**A of the housing **210**. The light emitting element **206** may provide, for example, state information of the electronic device **200** in an optical form. In another embodiment, the light emitting element **206** may provide, for example, a light source interworking with an operation of the camera module **205**. The light emitting element **206** may include, for example, an LED, an IR LED, and a xenon lamp.

The connector holes **208** and **209** may include the first connector hole **208** capable of accommodating a connector (e.g., a USB connector) for transmitting/receiving power and/or data of an external electronic device and/or the second connector hole (e.g., earphone jack) **209** capable of accommodating a connector for transmitting/receiving an audio signal with respect to the external electronic device.

Referring to FIG. **3**, an electronic device **300** (e.g., the electronic device **101** of FIG. **1** or the electronic device **200** of FIG. **2**A or FIG. **2**B) may include a side bezel structure **310**, a first support member **311** (e.g., a bracket), a front plate **320** (e.g., the front plate **202** of FIG. **2**A), a display **330** (e.g., the display **201** of FIG. **2**A), a Printed Circuit Board (PCB) **340**, a battery **350** (e.g., the battery **189** of FIG. **1**), a second support member **360** (e.g., a rear case), an antenna **370** (e.g., the antenna module **178** of FIG. **1**), and a rear plate **380** (e.g., the rear plate **211** of FIG. **2**B). In some embodiments, the electronic device **300** may omit at least one (e.g., the first support member **311** or the second support member **360**) of these components, or may additionally include other components. At least one of the components of the electronic device **300** may be the same as or similar to at least one of the components of the electronic device **200** of FIG. **2**A or FIG. **2**B, and redundant descriptions may not be repeated.

The first support member **311** may be coupled with the side bezel structure **310**, for example, by being disposed inside the electronic device **300**, or may be integrated with the side bezel structure **310**. The first support member **311** may be constructed of, for example, a metal material and/or a non-metal (e.g., polymer) material. The first support member **311** may have the display **330** (e.g., the display **201** of FIG. **2**A) joined to one face and the PCB **340** joined to the other face. A processor, a memory, and/or an interface may be mounted on the PCB **340**. The processor (e.g., the processor **120** of FIG. **1**) may include, for example, one or more of a central processing unit, an application processor, a graphic processing unit, an image signal processor, a sensor hub processor, and/or a communication processor.

The memory (e.g., the memory **130** of FIG. **1**) may include, for example, a volatile memory and/or a non-volatile memory.

The interface may include, for example, a High-Definition Multimedia Interface (HDMI), a Universal Serial Bus (USB) interface, an SD card interface, and/or an audio interface. The interface may electrically or physically couple, for example, the electronic device **300** with an external electronic device, and may include a USB connector, an SD card/MMC connector, or an audio connector.

The battery **350** may be a device for supplying power to at least one component of the electronic device **300**, and may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell. At least part of the battery **350** may be disposed, for example, to be substantially co-planar with the PCB **340**. The battery **350** may be disposed inside the electronic device **300**, and according to some embodiments, may be disposed to be detachable from the electronic device **300**.

The antenna **370** may be disposed between the rear plate **380** and the battery **350**. The antenna **370** may include, for example, a Near Field Communication (NFC) antenna, a wireless charging antenna, and/or a Magnetic Secure Transmission (MST) antenna. The antenna **370** may perform short-range communication, for example, with the external electronic device, or may wirelessly transmit/receive power required for charging. In another embodiment, an antenna structure may be constructed by at least part of the side bezel structure **310** and/or the first support member **311** or a combination thereof.

FIG. **4** is a block diagram illustrating an example electronic device including conductive structures for electrically coupling ground layers of FPCBs and a ground layer of a PCB according to an embodiment.

Referring to FIG. **4**, an electronic device **400** (e.g., the electronic device **101** of FIG. **1**, the electronic device **200** of FIG. **2**A or **2**B, or the electronic device **300** of FIG. **3**) may include at least one of a processor (e.g., including processing circuitry) **440** (e.g., the processor **120** of FIG. **1**), a communication module (e.g., including communication circuitry) **450** (e.g., the communication module **190** of FIG. **1**), a first antenna module (e.g., including an antenna) **421**, a second antenna module (e.g., including an antenna) **422**, a third antenna module (e.g., including an antenna) **423**, a fourth antenna module (e.g., including an antenna) **424**, a first Flexible Printed Circuit Board (FPCB) **431**, a second FPCB **432**, a third FPCB **433**, a fourth FPCB **434**, a first conductive structure (e.g., including a conductive material) **481**, a second conductive structure (e.g., including a conductive material) **482**, a third conductive structure (e.g., including a conductive material) **483**, and a fourth conductive structure (e.g., including a conductive material) **484**.

According to an embodiment, the processor **440** may include various processing circuitry, such as, for example, and without limitation, one or more of a central processing unit, a Graphic Processing Unit (GPU), an image signal processor of a camera, a baseband processor (or a Communication Processor (CP)), or the like. According to an embodiment, the processor **440** may be implemented as a System on Chip (SoC) or a System in Package (SIP).

According to an embodiment, the communication module **450** may include various communication circuitry and be electrically coupled to the first antenna module **421**, the second antenna module **422**, the third antenna module **423**, and the fourth antenna module **424** through the first FPCB **431**, the second FPCB **432**, the third FPCB **433**, or the fourth FPCB **434**. The communication module **450** may include, for example, a baseband processor or at least one communication circuit (e.g., IFIC or RFIC), etc. The communication module **450** may include, for example, a baseband processor separated from the processor **440** (e.g., an Application Processor (AP).

According to some embodiments, some of the first FPCB **431**, the second FPCB **432**, the third FPCB **433**, or the fourth FPCB **434** may be replaced with various other conductive paths such as a coaxial cable.

According to an embodiment, the communication module **450** may include at least one of a first communication module **451** and a second communication module **452** each of which include various communication circuitry. The electronic device **400** may further include one or more interfaces between the communication module **450** and the processor **440** to support communication between chips. The processor **440** and the first communication module **451** and/or the second communication module **452** may transmit or receive data using the interface between the chips (i.e., an inter-processor communication channel).

According to an embodiment, the first communication module **451** and/or the second communication module **452** may provide an interface for performing communication with different entities. The first communication module **451** may support wireless communication, for example, for a first network (not shown) which utilizes one or more antennas **460**. The second communication module **452** may support wireless communication, for example, for a second network (not shown) which utilizes the first antenna module **421**, the second antenna module **422**, the third antenna module **423**, and/or the fourth antenna module **424**.

According to an embodiment, the first network (not shown) or the second network (not shown) may include the network **199** of FIG. **1**. According to an embodiment, the first network may include a 4^{th} Generation (4G) network, and the second network may include a 5^{th} Generation (5G) network. The 4G network may support, for example, a Long-Term Evolution (LTE) protocol defined in 3GPP. The 5G network may support, for example, a New Radio (NR) protocol defined in 3GPP. According to various embodiments, the first network may relate to Wireless Fidelity (WiFi) or Global Positioning System (GPS).

According to an embodiment, the first communication module **451** may receive a high-frequency signal (hereinafter, a Radio Frequency (RF) signal) for a first network (e.g., a 4G network) through one or more antennas **460**, and may transmit the received RF signal to the processor **440** by modulating (e.g., down-converting) it into a low-frequency signal. The first communication module **451** may receive a broadband signal for the first network from the processor **440**, and may transmit the received baseband signal to the at least one antenna **460** by modulating (e.g., up-converting) it into an RF signal. According to an embodiment, the first communication module **451** may include a Radio Frequency Integrated Circuit (RFIC). According to various embodiments, when the RF signal is modulated into the baseband signal or when the baseband signal is modulated into the RF signal, an input of a Local Oscillator (LO) may be utilized.

According to an embodiment, the second communication module **452** may receive a baseband signal for the second network from the processor **440**. The second communication module **452** may up-covert the baseband signal into an IF signal utilizing an input of the LO (hereinafter, an LO signal), and may transmit the IF signal to the antenna modules **421**, **422**, **423**, and **424** through the FPCBs **431**, **432**, **433**, and **434**. The antenna modules **421**, **422**, **423**, and **424** may receive the IF signal from the communication module **450** through the FPCBs **431**, **432**, **433**, and **434**. The antenna modules **421**, **422**, **423**, and **424** may up-convert the IF signal into the RF signal utilizing the LO signal, and may transmit the RF signal to the outside through a plurality of antennas (not shown) included in the antenna modules **421**, **422**, **423**, and **424**.

According to an embodiment, the antenna modules **421**, **422**, **423**, and **424** may include a plurality of antennas (not shown), and may receive the RF signal through the plurality of antennas. The antenna modules **421**, **422**, **423**, and **424** may down-convert the RF signal into the IF signal utilizing the LO signal, and may transmit the IF signal to the second communication module **452** through the FPCBs **431**, **432**, **433**, and **434**. The second communication module **452** may receive the IF signal from the antenna modules **421**, **422**, 423, and 424 through the FPCBs 431, 432, 433, and 434. The second communication module 452 may down-convert the IF signal into the baseband signal utilizing the LO signal, and may transmit the baseband signal to the processor 440.

According to an embodiment, the second communication module 452 may include various communication circuitry, including, for example, and without limitation, an Intermediate Frequency Integrated Circuit (IFIC). The second communication module 452 may transmit and/or receive a first signal of a frequency band between about 5 GHz and about 15 GHz.

According to an embodiment, at least one of the first antenna module 421, the second antenna module 422, the third antenna module 423, and the fourth antenna module 424 may include, for example, an RFIC. At least one of the first antenna module 421, the second antenna module 422, the third antenna module 423, and the fourth antenna module 424 may, for example, transmit and/or receive a second signal of at least part (e.g., a frequency band between about 24 GHz and about 100 GHz, a frequency band between about 24 GHz and about 30 GHz, or a frequency band between about 37 GHz and about 40 GHz) of a band between about 6 GHz and about 100 GHz.

According to various embodiments, the first antenna module 421, the second antenna module 422, the third antenna module 423, and the fourth antenna module 424 may be disposed adjacent (e.g., within about 10 mm) to a side bezel structure (e.g., the side bezel structure 218 of FIG. 2A or the side bezel structure 310 of FIG. 3), thereby reducing EMI caused by neighboring elements. For example, returning to FIG. 2B, when viewed from above the rear plate 211, the first antenna module 421 may be disposed to an upper left portion, the second antenna module 422 may be disposed to an upper right portion, the third antenna module 423 may be disposed to a lower left portion, and the fourth antenna module 424 may be disposed to a lower right portion.

According to an embodiment, the electronic device 400 may include at least one of the conductive structures 481, 482, 483, and 484 (e.g., each including a conductive material or conductor) which electrically couple a ground layer (not shown) included in the FPCB 431, 432, 433, and 434 to a ground 490. For example, the conductive structures 481, 482, 483, and 484 may include the first conductive structure 481 which electrically couples the ground 490 with the ground layer included in the first FPCB 431, the second conductive structure 482 which electrically couples the ground 490 with a ground layer included in the second FPCB 432, the third conductive structure 483 which electrically couples the ground 490 with a ground layer included in the third FPCB 433, and the fourth conductive structure 484 which electrically couples the ground 490 with a ground layer included in the fourth FPCB 434. According to an embodiment, the ground 490 may be disposed to a PCB (not shown) on which, for example, the communication module 450 or the processor 440 is mounted.

According to an embodiment, if the ground layers of the FPCBs 431, 432, 433, and 434 are electrically coupled with the ground 490 by means of the conductive structures 481, 482, 483, and 484, when IF signals and LO signals are transmitted/received through the FPCBs 431, 432, 433, and 434 between the second communication module 452 and the antenna modules 421, 422, 423, and 424, electromagnetic noise (e.g., electromagnetic wave noise) generated inside the electronic device 400 or introduced from the outside of the electronic device 400 can be prevented from and/or reduce affecting transmission/reception of such a signal. For example, if the ground layers of the FPCBs 431, 432, 433, and 434 are electrically coupled with the ground 490 by means of the conductive structures 481, 482, 483, and 484, Electro Magnetic Interference (EMI) between one or more antennas 460 and the FPCBs 431, 432, 433, and 434 can be decreased.

According to an embodiment, if the ground layers of the FPCBs 431, 432, 433, and 434 are electrically coupled with the ground 490 by means of the conductive structures 481, 482, 483, and 484, EMI between elements may be decreased to reduce a loss for transmission/reception signals (e.g., IF signals and/or LO signals) between the second communication module 452 and the antenna modules 421, 422, 423, and 424.

According to an embodiment, when power, signals, and/or data is transmitted/received through the FPCBs 431, 432, 433, and 434 between the second communication module 452 and the antenna modules 421, 422, 423, and 424, an electromagnetic field may be formed in the FPCBs 431, 432, 433, and 434 due to a current flow. The electromagnetic field may add noise to a peripheral circuit, thereby causing EMI which may interrupt a normal operation of the peripheral circuit. According to an embodiment, when the ground layers of the FPCBs 431, 432, 433, and 434 are electrically coupled with the ground 490 by means of the conductive structures 481, 482, 483, and 484, the EMI can be decreased. For example, the electronic device 400 may include a camera module adjacent to the FPCBs 431, 432, 433, and 434 or disposed around theme. When the ground layers of the FPCBs 431, 432, 433, and 434 are electrically coupled with the ground 490 by means of the conductive structures 481, 482, 483, and 484, an electromagnetic effect for an operational clock of the camera module can be decreased.

According to various embodiments, the first communication module 451 and/or the second communication module 452 may be included in one module together with the processor 440. For example, the first communication module 451 and/or the second communication module 452 may be integrally formed together with the processor 440. According to some embodiments, the first communication module 451 and/or the second communication module 452 may be disposed inside one chip, or may be in a form of an independent chip.

According to an embodiment, the processor 440 and one communication module (e.g., the first communication module 451) may be integrally formed inside one chip (SoC chip), and another single communication module (e.g., the second communication module 451) may be formed as an independent chip.

FIG. 5 is a block diagram illustrating an example antenna module according to an embodiment.

Referring to FIG. 5, an antenna module (e.g., including at least one antenna) 500 (e.g., the first antenna module 421, second antenna module 422, third antenna module 423, or fourth antenna module 424 of FIG. 4) may include at least one of a first antenna array (e.g., including at least one antenna) 510, a second antenna array (e.g., including at least one antenna) 520, a communication circuit 530, and a PCB 540.

According to an embodiment, at least one of the first antenna array 510, the second antenna array 520, and the communication circuit 530 may be disposed to (e.g., on) the PCB 540. For example, the first antenna array 510 and/or the second antenna array 520 may be disposed to a first face of the PCB 540, and the communication circuit 530 may be disposed to a second face (e.g., a face facing away from the first face) of the PCB 540. The PCB 540 may include a connector for electrically coupling another PCB (e.g., a PCB on which the communication module **450** of FIG. **4** is disposed) using a transmission path (e.g., the FPCB **431**, second FPCB **432**, third FPCB **433**, or fourth FPCB **434** of FIG. **4**). The PCB **540** may be coupled through a PCB on which a communication module (e.g., the communication module **450** of FIG. **4**.) is disposed and one or more FPCBs (e.g., the FPCBs **431**, **432**, **433**, and **434** of FIG. **4**) using, for example, a connector. According to an embodiment, the at least one FPCB may be utilized to transfer an Intermediate Frequency (IF) signal or Radio Frequency (RF) signal for transmission and reception in a corresponding network (e.g., a 5G network). Power and/or other control signals may be transferred through the at least one FPCB.

According to an embodiment, the first antenna array **510** and/or the second antenna array **520** may have a structure in which a plurality of antennas (or antenna elements) having substantially the same shape are arranged or a plurality of antennas are arranged with a specific interval. According to an embodiment, a plurality of antennas included in the first antenna array **510** or the second antenna array **520** may include, for example, and without limitation, a patch antenna, a loop antenna, and/or a dipole antenna, or the like. For example, at least part of the plurality of antennas included in the first antenna array **510** may include a path antenna to form a beam towards a rear plate (e.g., the rear plate **211** of FIG. **2**B) of an electronic device (e.g., the electronic device **200** of FIG. **2**A or **2**B). For example, at least part of the plurality of antennas included in the second antenna array **520** may include a dipole antenna or loop antenna to form a beam towards a side member (e.g., the side bezel structure **218** of FIG. **2**A) of the electronic device (e.g., the electronic device **200** of FIG. **2**A or **2**B).

According to an embodiment, the communication circuit **530** may, for example, transmit and/or receive a second signal of at least part (e.g., a frequency band between about 24 GHz and about 100 GHz, a frequency band between about 24 GHz and about 30 GHz, or a frequency band between about 37 GHz and about 40 GHz) of a band between about 6 GHz and about 100 GHz. According to an embodiment, the communication circuit **530** may up-convert and/or down-convert a frequency for a signal transmitted/received in wireless communication. For example, the communication circuit **530** may receive an IF signal received through an FPCB (e.g., the FPCBs **431**, **432**, **433**, and **434**) from a communication module (e.g., the communication module **450** of FIG. **4**), and may up-convert the received IF signal into an RF signal. For example, the communication circuit **530** may down-convert an RF signal received through a plurality of antennas included in the first antenna array **510** or second antenna array **520** into an IF signal, and may provide the IF signal to the communication module (e.g., the communication module **450** of FIG. **4**).

FIG. **6** is a perspective view illustrating an example antenna module according to an embodiment.

Referring to FIG. **6**, an antenna module (or an antenna structure) **600** (e.g., the antenna module **500** of FIG. **5**) may include at least one of a first antenna array **610** (e.g., the first antenna array **510** of FIG. **5**), a second antenna array **620** (e.g., the second antenna array **520** of FIG. **5**), a communication circuit **630** (e.g., the communication circuit **530** of FIG. **5**), and a PCB **640** (e.g., the PCB **540** of FIG. **5**).

According to an embodiment, the first antenna array **610** and/or the second antenna array **620** may, for example, be disposed to a first face **640***a* of the PCB **640**, and the communication circuit **630** or various electric elements (e.g., passive elements or active elements) **631** related thereto may, for example, be disposed to a second face (e.g., a face facing away from the first face **640***a*) of the PCB **640**.

According to some embodiments, the first antenna array **610** and/or the second antenna array **620** may be implemented as a circuit included in an inner layer of the PCB **640**. The first antenna array **610** and/or the second antenna array **620** may be electrically coupled with the communication circuit **630** through a circuit (or a wiring) of at least one inner layer included in the PCB **640**.

According to an embodiment, the PCB **640** may include a structure including inner layers on which a circuit is formed using, for example, Copper Clad Laminates (CCL), first and second outer layers which are disposed at both sides of the inner layers and on which a circuit is formed, and prepregs which bond or isolate one layer from another, and may be electrically coupled through a VIA formed on the PCB **640**. According to an embodiment, a circuit included in a first outer layer may include the first antenna array **610** or the second antenna array **620**, and a circuit included in a second outer layer may include pads (or terminals) for mounting the communication circuit **630** by using a conductive material such as a solder.

According to some embodiments, the first antenna array **610** and/or the second antenna array **620** may be formed utilizing a conductive paint separately coated on the metal plate PCB **640** separately attached to the PCB **640**.

According to an embodiment, the first antenna array **610** and/or the second antenna array **620** may increase an antenna gain by overcoming a high free spatial loss depending on a frequency characteristic, in wireless communication which utilizes, for example, a millimeter wave at least about 20 GHz. The number of antenna elements is not limited to the illustrated example, and may vary by considering an antenna gain or a size of the PCB **640**.

According to an embodiment, antenna elements **610***a*, **610***b*, and **610***c* included in the first antenna array **610** may include, for example, a patch antenna. Antenna elements **620***a*, **620***b*, **620***c*, and **620***d* included in the second antenna array **620** may include, for example, a dipole antenna or a loop antenna. According to an embodiment, when the antenna module **600** is mounted to an electronic device (e.g., the electronic device **200** of FIG. **2**A or **2**B or the electronic device **300** of FIG. **3**), the first antenna array **610** may form a beam towards a rear plate (e.g., the rear plate **211** of FIG. **2**B or the rear plate **380** of FIG. **3**) of the electronic device, and may form a beam towards a side bezel structure (e.g., the size bezel structure **218** of FIG. **2**A or the side bezel structure **310** of FIG. **3**) of the electronic device.

According to an embodiment, the antenna module **600** may include a beam forming system which processes a transmission or reception signal so that energy radiated from an antenna element is concentrated in a specific direction in a space. The beam forming system may receive a signal with higher strength in a desired direction or transfer the signal in the desired direction, or may not receive a signal coming from an undesired direction. The beam forming system may adjust a direction and shape of a beam by using an amplitude or phase difference of a carrier signal in an RF band, and according to an embodiment, may include phase shifters for adjusting a phase for each antenna element. According to an embodiment, the beam forming system may control each antenna element to have a phase difference. For example, assuming that the antenna module includes a first antenna element and a second antenna element, a communication circuit (e.g., the communication circuit **630** of FIG. **6**) may include a first electrical path electrically coupled with a first point on the first antenna element and a second electrical path electrically coupled with a second point on the second antenna element. The communication circuit may provide a phase difference between a first signal at the first point and a second signal at the second point.

According to an embodiment, the antenna elements **610***a*, **610***b*, **610***c*, **620***a*, **620***b*, **620***c*, and **620***d* may be electrically coupled with the communication circuit **630** through, for example, RF chains. For example, one antenna element may be electrically coupled with the communication circuit **630** in a single feeding manner through one RF chain. For example, one antenna element may be electrically coupled with the communication circuit **630** in a dual feeding manner through two RF chains, and without being limited thereto, may be electrically coupled with the communication circuit **630** in a multi feeding manner trough two or more RF chains. According to an embodiment, a phase shifter may be prepared for each RF chain to perform feeding such that an antenna element has specific phase(s) through RF chain(s).

According to various embodiments, in order to decrease an antenna gain deterioration caused by mutual interference between antenna elements, various feeding structures (e.g., multi-feeding) may be prepared for the first antenna array **610** or the second antenna array **620**.

According to various embodiments, one of the first antenna array **610** and the second antenna array may be omitted.

According to various embodiments, the PCB **640** may include an antenna matching circuit. A radiation feature and impedance of the first antenna array **610** or second antenna array **620** may be associated with antenna performance, and may vary depending on a shape and size of the antenna element and a material of the antenna element. The radiation feature of the antenna element may include an antenna radiation pattern (or an antenna pattern) which may be a directivity function exhibiting relative distribution of power radiated from the antenna element, and a polarization state (or an antenna polarization) of a radio wave radiated from the antenna element. Impedance of the antenna element may relate to power transfer from a transmitter to the antenna element or power transfer from the antenna element to a receiver. In order to minimize and/or reduce a reflection at a connection portion between the transmission line and the antenna element, the impedance of the antenna element may be designed to be matched with impedance of the transmission path. Accordingly, maximum/increased power transfer (or power loss minimization/reduction) or effective signal transfer may be possible through the antenna element. Impedance matching may lead to an efficient signal flow at a specific frequency (or a resonant frequency). Impedance mismatching may cause a power loss or a transmission/reception signal decrease, thereby deteriorating communication performance. According to an embodiment, at least one electrical element **631** mounted on the PCB **640** may be utilized as a frequency control circuit for resolving the impedance mismatching. According to an embodiment, the frequency control circuit may shift the resonant frequency to a designated frequency, or may shift the resonant frequency by a designated level.

According to various embodiments, a signal related to wireless communication, power, or other various functions may be transferred from a PCB (e.g., the communication module **450** of FIG. **4** or a PCB having the processor **440** disposed thereon) through an FPCB (e.g., the FPCBs **431**, **432**, **433**, and **434**), and one or more electrical elements **631** mounted on the PCB **640** may include passive elements or active elements related to transmission/reception of the signal.

According to an embodiment, the antenna module **600** may include a connector **641** disposed to a second face (a face facing away from the first face **640***a*). One end of the PCBs **431**, **432**, **433**, and **434** of FIG. **4** may include terminals, and may be electrically coupled with the antenna module **600** when inserted to an opening **642** of the connector **641**. According to some embodiments, one end of the FPCBs **431**, **432**, **433**, and **434** of FIG. **4** may be electrically coupled with lands (conductive pads) prepared on a second face (a face facing away from the first face **640***a*) using a conductive material such as a solder. In this case, the connector **641** may be omitted.

FIG. **7**A is an exploded perspective view illustrating an example electronic device according to an embodiment. FIG. **7**B is a cross-sectional view of section A-A in FIG. **7**A. FIG. **7**C is a front view illustrating an example FPCB and an example conductive structure according to an embodiment.

Referring to FIG. **7**A, an electronic device **700** (e.g., the electronic device **101** of FIG. **1**, the electronic device **200** of FIG. **2**A or **2**B, the electronic device **300** of FIG. **3**, or the electronic device **400** of FIG. **4**) may include at least one of housings **701**, **702**, and **703**, a display **704**, a first PCB **710**, an FPCB **720**, a conductive structure (e.g., including a conductive material) **730**, an antenna structure (e.g., including at least one antenna) **740**, and a first wireless communication circuit **750**.

The housings **701**, **702**, and **703** (e.g., the housing **210** of FIG. **2**A or **2**B) may include, for example, the first plate **701** (e.g., the front plate **202** of FIG. **2**A or the front plate **320** of FIG. **3**), the second plate **702** (e.g., the rear plate **211** of FIG. **2**B or the rear plate **380** of FIG. **3**) facing away from the first plate **701**, and the side member **703** (e.g., the side bezel structure **218** of FIG. **2**A or **2**B or the side bezel structure **310** of FIG. **3**) surrounding a space between the first plate **701** and the second plate **702**.

The display **704** (e.g., the display **201** of FIG. **2**A or the display **330** of FIG. **3**) may be exposed, for example, through at least part of the first plate **701**.

According to an embodiment, the first PCB **710** may be disposed between the first plate **701** (or the display **704**) and the second plate **702**. The first PCB **710** may include a third face **7101** and a fourth face (not shown) facing away from the third face **7101**. For example, the third face **7101** may face the second plate **702**, and the fourth face may face the display **704**.

According to an embodiment, the first PCB **710** may include ground patterns, and at least some patterns **714** and **715** of the ground patterns may be formed on the third face **7101**, which is an outer layer of the first PCB **710**, to comprise a first ground layer. When the plurality of ground patterns **714** and **715** are formed on the third face **7101** to comprise the first ground layer, the plurality of ground patterns **714** and **715** may be electrically coupled through a via (not shown) or another ground layer (not shown). At least some patterns **714** and **715** of the ground patterns according to various embodiments disclosed in the disclosure may be referred to as 'first ground layers'.

According to an embodiment, a first connector **711** which electrically couples a first end **721** of the FPCB **720** may be disposed on the third face **7101** of the first PCB **710**. According to an embodiment, the first wireless communication circuit **750** (e.g., the second communication module **452** of FIG. **4**) may be disposed on the third face **7101** of the first PCB **710**, and may be electrically coupled with the first connector **711**. According to some embodiments, the first wireless communication circuit **750** may be disposed to a third PCB (not shown) disposed to overlap with the first PCB **710**.

According to an embodiment, the FPCB **720** may include the first end **721** electrically coupled with the first PCB **710** and a second end **722** electrically coupled with the antenna structure **740**. For example, the FPCB **720** may, for example, include one of the first FPCB **431**, second FPCB **432**, third FPCB **433**, and fourth FPCB **434** of FIG. **4**. The first end **721** may be electrically coupled with the first connector **711**, and the second end **722** may be coupled with a second connector **741** included in the antenna structure **740**. The antenna structure **740** may be electrically coupled with the first wireless communication circuit **750** mounted on the first PCB **710** through the FPCB **720**.

According to an embodiment, the antenna structure **740** (e.g., the first antenna module **41**, second antenna module **422**, third antenna module **423**, and fourth antenna module **424** of FIG. **4** or the antenna module **600** of FIG. **6**) may include a second PCB **742** having a first face **7401** and a second face (not shown) facing away from the first face **7401**. According to an embodiment, the second PCB **742** may be disposed such that the second face faces the third face **7101** of the first PCB **710**. For example, the second PCB **742** may be disposed substantially in parallel with the first PCB **710**. According to various embodiments, although not shown, a support member for supporting the second PCB **742** with respect to the first PCB **710** may be disposed between the first PCB **710** and the second PCB **742**. According to various embodiments, the insulating support member may include an adhesive a cohesive material (or an adhesive material). According to some embodiments, the second PCB **742** may be joined to the first PCB **710** utilizing a bolt.

According to some embodiments, although not shown, the second PCB **742** may be disposed substantially with an angle of 90 degrees or an acute angle with respect to the first PCB **710**. For example, the second PCB **742** may be disposed between the side member **703** and the first PCB **710**, and may be perpendicular to the first PCB **710**. According to an embodiment, the second PCB **742** may be joined to the side member **703**.

According to an embodiment, the second PCB **742** may include at least one of conductive patterns **743** and **744** disposed on the first face **7401**. The conductive patterns **743** and **744** may be utilized as antenna radiators, and may include, for example, the first antenna array **743** (e.g., the first antenna array **510** of FIG. **5** or the first antenna array **610** of FIG. **6**) and/or the second antenna array **744** (e.g., the second antenna array **520** of FIG. **5** or the second antenna array **620** of FIG. **6**).

According to an embodiment, the second PCB **742** may include a second wireless communication circuit **745** (e.g., the communication circuit **530** of FIG. **5** or the communication circuit **630** of FIG. **6**) disposed on the second face (e.g., a face facing away from the first face **7401**). The second wireless communication circuit **745** may perform wireless communication of a corresponding communication band utilizing the first antenna array **743** and/or the second antenna array **744**.

According to an embodiment, the second wireless communication circuit **745** may receive an IF signal from the first wireless communication circuit **750** (e.g., the second communication module **452** of FIG. **4**) through the FPCB **720**, and may up-convert the received IF signal into an RF signal and transmit the RF signal to the outside through the first antenna array **743** and/or the second antenna array **744**.

According to an embodiment, the second wireless communication circuit **745** may down-convert an RF signal (e.g., a millimeter wave signal) received through the first antenna array **743** and/or the second antenna array **744** into an IF signal, and may transmit the IF signal to the first wireless communication circuit **750** (e.g., the second communication module **452** of FIG. **4**) through the FPCB **720**.

According to an embodiment, the first wireless communication circuit **750** may include an IFIC. For example, the second communication module **452** may transmit and/or receive a first signal of a frequency band between about 5 GHz and about 15 GHz.

According to an embodiment, the second wireless communication circuit **745** may include an RFIC. For example, the second wireless communication circuit **745** may transmit and/or receive a second signal of at least part (e.g., a frequency band between about 24 GHz and about 100 GHz, a frequency band between about 24 GHz and about 30 GHz, or a frequency band between about 37 GHz and about 40 GHz) of a band between about 6 GHz and about 100 GHz.

According to some embodiments, at least part of the first antenna array **743** and/or the second antenna array **744** may be disposed to a second face (e.g., a face facing away from the first face **7401**) of the second PCB **742**.

According to some embodiments, the second wireless communication circuit **745** may be disposed to the first face **7401** of the second PCB **742**. According to various embodiments, the second wireless communication circuit **745** may be disposed to the same face (e.g., the first face **7401** or the second face) as the first antenna array **743** or the second antenna array **744**.

According to some embodiments, the first antenna array **743** and/or the second antenna array **744** may be implemented as a circuit included in an inner layer of the second PCB **742**. The first antenna array **743** and/or the second antenna array **744** may be electrically coupled with the second wireless communication circuit **745** through a circuit (or a wiring) of at least one inner layer included in the second PCB **742**.

According to various embodiments, the second PCB **742** may include a structure including inner layers on which a circuit is formed using Copper Clad Laminates (CCL), first and second outer layers which are disposed at both sides of the inner layers and on which a circuit is formed, and prepregs which bond or isolate one layer from another, and may be electrically coupled through a VIA formed on the second PCB **742**. According to an embodiment, a circuit included in a first outer layer may include a first antenna array **743** and/or a second antenna array **744**, and a circuit included in a second outer layer may include pads (or terminals) for mounting the second communication circuit **745** by using a conductive material such as a solder.

According to an embodiment, the electronic device **700** may include the conductive structure **730** (e.g., the first conductive structure **481**, second conductive structure **482**, third conductive structure **483**, or fourth conductive structure **484** of FIG. **4**) which electrically couples a second ground (not shown) of the FPCB **720** with the first ground layers **714** and **715** (e.g., the ground **490** of FIG. **4**) of the first PCB **170**.

In an embodiment, the conductive structure **730** may include a first conductive portion **731** electrically coupled at a first position **716** of the first ground layers **714** and **715**. The conductive structure **730** may include a second conductive portion **732** electrically coupled at a second position (not shown), different from the first position **716**, of the first ground layers **714** and **715**. The conductive structure **730** may include a third conductive portion **733** electrically coupled between the first portion **731** and the second portion **732**. The third conductive portion **733** may be electrically coupled with the second ground layer of the second PCB **742**.

According to an embodiment, the conductive structure **730** may support the FPCB **720**, and the FPCB **720** may maintain a state of being spaced apart from the first PCB **710**. Referring to FIG. 7A and FIG. 7B, the third conductive portion **733** may couple one end **7311** of the first conductive portion **731** and one end **7321** of the second conductive portion **732**, and may be spaced apart by a first height H1 from the third face **7101** of the first PCB **710**. For example, the third conductive portion **733** may include a planar plate which is substantially parallel with the third face **7101** of the first PCB **710**. According to some embodiments, although not shown, the third conduct portion **733** may be designed not to be parallel with the third face **7101** of the first PCB **710**.

According to various embodiments, although not shown, the third conductive portion **733** may be formed in a convex shape in a direction **7002** facing the first plate **701** to the second plate **702** or a direction **7001** opposite to the direction **7002**.

According to various embodiments, although not shown, a region **7331** overlapping with the FPCB **720** of the third conductive portion **733** may have a concave shape in the direction **7002** facing the first plate **701** to the second plate **702** or the direction **7001** opposite to the direction **7002**. In addition thereto, the third conductive portion **733** may be formed in various other shapes.

Referring to FIG. 7C, in an embodiment, the FPCB **720** may include exposure regions **723** and **724** facing the third conductive portion **733** of the conductive structure **730**. The exposure regions **723** and **724** may be electrically coupled with a second ground layer included in the FPCB **720**, or may be part of the second ground layer. The FPCB **720** may include a first edge **7201** and second edge **7202** at both sides, which define a width W thereof. According to an embodiment, the exposure regions **723** and **724** may include the first exposure region **723** extended from the first edge **7201** towards the second edge **7202** and the second exposure region **724** extended from the second edge **7202** towards the first edge **7201**. Various conductive materials such as a solder or a conductive tape may be disposed between the first exposure region **723** and the portion **7332** of the third conductive portion **733** overlapping therewith and between the second exposure region **724** and the portion **7333** of the third conductive portion **733** overlapping therewith. According to an embodiment, the first exposure region **723** and the second exposure region **724** may be joined with the third conductive portion **733** utilizing ultrasonic welding.

According to various embodiments, one of the first exposure region **723** and the second exposure region **724** may be omitted.

According to various embodiments, a width W1 of the first exposure region **723** and a width W2 of the second exposure region **724** may be identical to or different from each other.

According to various embodiments, the first exposure region **723** or the second exposure region **724** may change to a different position between the first edge **7201** and the second edge **7202**.

According to an embodiment, the first exposure region **723** or the second exposure region **724** may be extended from the first end **721** to the second end **722**.

According to various embodiments, an exposure region of the FPCB **720** electrically coupled with the third conductive portion **722** may not be limited to a position, size, or count illustrated in FIG. 7C. For example, at least part of a region overlapping with the third conductive portion **733** in the FPCB **720** may be formed as an exposure region.

Referring to FIG. 7A and FIG. 7B, in an embodiment, one end **7312** of the first conductive portion **731** and one end **7322** of the second conductive portion **732** may be electrically coupled with at least part of the first ground layers **714** and **715**. For example, the end **7312** of the first conductive portion **731** and the end **7322** of the second conductive portion **732** may be electrically coupled with the first ground layers **714** and **715** by using a conductive material such as a solder. According to an embodiment, the first PCB **710** may include a land (not shown) which is a portion to be joined with the end **7312** of the first conductive portion **731** by using a conductive material such as a solder. The first PCB **710** may include a land (not shown) which is a portion to be joined with the end **7322** of the second conductive portion **732** by using a conductive material such as a solder.

Referring to FIG. 7A and FIG. 7B, in an embodiment, the FPCB **720** may be electrically coupled with a rear face **733***b* (e.g., a face facing the third face **7101** of the first PCB **710**) of the third conductive portion **733**. According to some embodiments, although not shown, the FPCB **720** may be electrically coupled with a front face **733***a* (e.g., the rear plate **702**) of the third conductive portion **733**.

According to an embodiment, if a second ground layer of the FPCB **720** is electrically coupled with the first ground layers **714** and **715** of the first PCB **710** by means of the conductive structure **730**, when signals (e.g., IF signals and LO signals) are transmitted and/or received through the FPCB **720** between the first wireless communication circuit **750** and the antenna structure **730**, electromagnetic noise generated inside the electronic device **700** and/or introduced from the outside of the electronic device **700** can be prevented from and/or may reduce affecting transmission and/or reception of such a signal.

According to an embodiment, if a second ground layer of the FPCB **720** is electrically coupled with the first ground layers **714** and **715** of the first PCB **710** by means of the conductive structure **730**, EMI between the FPCB **720** and its peripheral circuit (e.g., electronic components **780** at least partially overlapping with the FPCB **720** of FIG. 7B) can be decreased.

According to an embodiment, if the second ground layer of the FPCB **720** is electrically coupled with the first ground layers **714** and **715** of the first PCB **710** by means of the conductive structure **730**, a loss can be decreased for transmission/reception signals (e.g., IF signals and/or LO signals) between the first wireless communication circuit **750** and the antenna structure **740**.

According to various embodiments, a conductive structure for decreasing EMI may not be limited to the position or count of FIG. 7A.

FIG. **8**A is a perspective view illustrating an example first PCB, an example FPCB, and an example conductive structure according to an embodiment. FIG. **8**B is a cross-sectional view of section B-B in FIG. **8**A.

Referring to FIG. **8**A, in an embodiment, a first PCB **810** (e.g., the first PCB **710** of FIG. 7A) may include ground patterns, and at least some patterns **814** and **815** of the ground patterns may be formed on a third face **8101**, which is an outer layer of the first PCB **810**, to comprise a first ground layer. When the plurality of ground patterns **814** and **815** are formed on the third face **8101** to comprise the first ground layer, the plurality of ground patterns **814** and **815** may be electrically coupled through a via (not shown) or another ground layer (not shown). At least some patterns **814** and **815** of the ground patterns according to various embodiments disclosed in the disclosure may be referred to as 'first ground layers'.

According to an embodiment, a third connector **860** and fourth connector **870** electrically coupled with the first ground layers **814** and **815** may be disposed on the third face **8101** of the first PCB **810**. The third connector **860** may be electrically connected at a first position (not shown) of the first ground layers **814** and **815**, and the fourth connector **870** may be electrically coupled at a second position (not shown) different from the first position of the first ground layers **814** and **815**.

According to an embodiment, a conductive structure **830** may include a first conductive portion **831** electrically coupled with the third connector **860**. The conductive structure **830** may include a second conductive portion **832** electrically coupled with the fourth connector **870**. The conductive structure **830** may include a third conductive portion **833** electrically coupled between the first portion **831** and the second portion **832**.

According to an embodiment, an FPCB **820** (e.g., the FPCB **720** of FIG. **7**A) may be disposed between the third conductive portion **833** and the third face **8101** of the first PCB **810**, and may be electrically coupled with a rear face (e.g., a face facing the third face **8101**) of the third conductive portion **833**. For example, a second ground layer (not shown) of the FPCB **820** may be electrically coupled with the third conductive portion **833**, and thus may be electrically coupled with the first ground layers **814** and **815** of the first PCB **810** through the conductive structure **830**.

According to an embodiment, the third conductive portion **833** and the second ground layer of the FPCB **820** may be electrically coupled utilizing, for example, the embodiment of FIG. **7**C. For example, the FPCB **820** may include at least one exposure region (e.g., the exposure regions **723** and **724**) facing the third conductive portion **833**. A conductive material may be disposed between the third conductive portion **833** and at least one exposure region, and thus the FPCB **820** may be electrically coupled with the third conductive portion **833** while being joined to the third conductive portion **833**.

Referring to FIG. **8**A and FIG. **8**B, in an embodiment, the third connector **860** may include a plate **861** disposed on the third face **8101** of the first PCB **810** and electrically coupled with the first ground layers **814** and **815** and a first side wall **862** and second side wall **863** extended from both edges of the plate **861** to face each other. For example, the plate **861**, the first side wall **862**, and the second side wall **863** may be integrally constructed with a conductive material. The third connector **860** may include a recess **864** formed by the plate **861**, the first side wall **862**, and the third side wall **863**. If a portion **8313** of the first conductive portion **831** is inserted to the recess **864**, the first conductive portion **831** may be physically in contact with the plate **861**, the first side wall **862**, or the second side wall **863**.

According to an embodiment, the first side wall **862** or the second side wall **863** may be designed to elastically press one portion **8313** of the first conductive portion **831** inserted to the recess **864**, thereby improving electrical connectivity between the third connector **860** and the first conductive portion **831**.

According to an embodiment, the fourth connector **870** may provide a recess **874** by including a plate **871**, a first side wall **872**, and a second side wall **873**, substantially similarly to the third connector **860**. If one portion **8323** of the second conductive portion **832** is inserted to the recess **874**, it may be electrically coupled with the fourth connector **870**. According to various embodiments, the third connector **860** and/or the fourth connector **870** may, for example, be a metal clip.

According to an embodiment, the FPCB **820** may be joined with the third conductive portion **833** of the conductive structure **830**, and the conductive structure **830** may be utilized as a support which props the FPCB **820**, thereby providing a robust structure between the FPCB **820** and the PCB **810**.

FIG. **9**A is a perspective view illustrating an example first PCB, an example FPCB, and an example conductive structure according to an embodiment. FIG. **9**B is a cross-sectional view of section C-C in FIG. **9**A.

Referring to FIG. **9**A, in an embodiment, a first PCB **910** (e.g., the first PCB **710** of FIG. **7**A) may include ground patterns, and at least some patterns **914** and **915** of the ground patterns may be formed on a third face **9101**, which is an outer layer of the first PCB **910**, to comprise a first ground layer. When the plurality of ground patterns **914** and **915** are formed on the third face **9101** to comprise the first ground layer, the plurality of ground patterns **914** and **915** may be electrically coupled through a via (not shown) or another ground layer (not shown). At least some patterns **914** and **915** of the ground patterns according to various embodiments disclosed in the disclosure may be referred to as 'first ground layers'.

According to an embodiment, a conductive structure **930** may include a first conductive member **931** and second conductive member **932** disposed on the third face **9101** (e.g., the third face **7101** of FIG. **7**A) of the first PCB **910**. For example, the first conductive member **931** may be electrically coupled at a first position (not shown) of the first ground layers **914** and **915**, and the second conductive member **932** may be electrically coupled at a second position (not shown) different from the first position of the first ground layers **914** and **915**. The conductive structure **930** may include a conductive plate **933** electrically coupled with the first conductive member **931** and the second conductive member **932**, and the conductive plate **933** may be spaced apart from the third face **9101** of the first PCB **910**.

Referring to FIG. **9**A and FIG. **9**B, the first conductive member **931** may include a fifth face **931***a* facing the third face **9101**, and the fifth face **931***a* may be electrically coupled with the first ground layers **914** and **915**. The first conductive member **931** may include a sixth face **931***b* facing away from the fifth face **931***a*, and the sixth face **931***b* may be disposed at a position spaced apart by a second height H2 from the third face **9101**. The sixth face **931***b* may face a rear face **933***b* of the conductive plate **933**, and may be electrically coupled therewith.

According to an embodiment, the second conductive member **932** may include a fifth face **932***a* electrically coupled with the first ground layers **914** and **915** and a sixth face **932***b* electrically coupled with the conductive plate **933**, substantially similarly to the first conductive member **931**.

According to an embodiment, the conductive plate **933** (e.g., the FPCB **720** of FIG. **7**A or the FPCB **820** of FIG. **8**A) may include the rear face **933***b* facing an FPCB **920** and a front face **933***a* facing away from the rear face **933***b*. According to an embodiment, the FPCB **920** may be disposed on the front face **933***a* of the conductive plate **933**, and may be electrically coupled with the conductive plate **933**. For example, a second ground (not shown) of the FPCB **920** may be electrically coupled with the first ground layers **914** and **915** of the first PCB **910** through the conductive structure **930**.

According to other embodiments, the FPCB **920** (e.g., the FPCB **720** of FIG. **7**A or the FPCB **820** of FIG. **8**A) may be disposed between the conductive plate **833** and the third face **9101** of the first PCB **910**, and may be electrically coupled with the rear face **933***b* of the plate **933**.

According to an embodiment, the plate **933** and the second ground layer of the FPCB **920** may be electrically coupled utilizing the embodiment of FIG. **7**C. For example, the FPCB **920** may include at least one exposure region (e.g., the exposure regions **723** and **724**) facing the conductive portion **933**. A conductive material may be disposed between the conductive portion **933** and at least one exposure region, and thus the FPCB **920** may be electrically coupled with the conductive portion **933** while being joined to the conductive portion **933**. According to an embodiment, the conductive structure **930** may be utilized as a support which props the FPCB **920**, thereby providing a robust structure between the FPCB **920** and the PCB **910**.

According to various embodiments, the first conductive member **931** or the second conductive member **932** may include a non-conductive housing (not shown), the fifth faces **931***a* and **932***a* of the non-conductive housing, and a conductor for providing electrically coupling between the sixth faces **931***b* and **932***b* of the housing. For example, the conductor may include a first terminal disposed on the fifth faces **931***a* and **932***b* of the non-conductive housing, a second terminal disposed on the sixth faces **931***b* and **932***b* of the non-conductive housing, and a conductive path disposed on an outer face of the non-conductive housing or inside thereof to electrically couple the first terminal and the second terminal. According to various embodiments, the first conductive member **931** or the second conductive member **932** may be an interposer, a connector, or a coupling member.

According to various embodiments, the first conductive member **931** and/or the second conductive member **932** may include a PCB formed together with the first PCB **910** or formed separately from the first PCB **910**. For example, the first conductive member **931** or the second conductive member **932** may be a PCB including one or more inner layers on which a circuit is formed by using a CCL.

FIG. **10**A is an exploded perspective view illustrating an example electronic device including an example conductive structure for electrically coupling a ground layer of an FPCB and a ground layer of a PCB according to an embodiment. FIG. **10**B is a front view illustrating an example first PCB and an example conductive structure in the electronic device of FIG. **10**A. FIG. **10**C is a cross-sectional view of section D-D in FIG. **10**A.

Referring to FIG. **10**A, an electronic device **1000** (e.g., the electronic device **101** of FIG. **1**, the electronic device **200** of FIG. **2**A or **2**B, the electronic device **300** of FIG. **3**) may include at least one of housings **1001**, **1002**, and **1003**, a display **1004**, a first PCB **1010**, an FPCB **1020**, a metal cover **1030**, a metal sheet (or a metal plate) **1060**, an antenna structure **1040**, and a first wireless communication circuit **1050**.

The housings **1001**, **1002**, and **1003** may be similar or identical to, for example, the housings **701**, **702**, and **703** of FIG. **7**A. The housings **1001**, **1002**, and **1003** may include the first plate **1001** (e.g., the first plate **701** of FIG. **7**A), the second plate **1002** (e.g., the second plate **702** of FIG. **7**A), and/or the side bezel structure **1003** (e.g., the side member **703** of FIG. **7**A).

The display **1040** may be similar or identical to, for example, the display **704** of FIG. **7**A, and may be exposed through at least part of the first plate **1001**.

The first PCB **1010** may be similar or identical to, for example, the first PCB **710** of FIG. **7**A. The first PCB **1010** may be disposed between the first plate **1001** (or the display **1004**) and the second plate **1002**, and may include at least one of first ground layers **1014** and **1015** (e.g., the ground **490** of FIG. **4**, or the first ground layers **714** and **715** of FIG. **7**A).

The FPCB **1020** may be similar or identical to, for example, the FPCB **720** of FIG. **7**A. The FPCB **1020** may include a first end **1021** (e.g., the first end **721** of FIG. **7**A) electrically coupled with a first connector **1011** (e.g., the first connector **711** of FIG. **7**A) mounted on the first PCB **1010** and a second end **1022** (e.g., the second end **722** of FIG. **7**A) electrically coupled with a second connector **1041** (e.g., the second connector **741** of FIG. **7**A) mounted on the antenna structure **1040** (e.g., the antenna structure **740** of FIG. **7**A).

The antenna structure **1040** may be similar or identical to, for example, the antenna structure **740** of FIG. **7**A. The antenna structure **1040** may include one or more conductive patterns **1043** and **1044** (e.g., the conductive patterns **743** and **744** of FIG. **7**A) disposed to a first face **10401** and a second wireless communication circuit **1045** (e.g., the second wireless communication circuit **745** of FIG. **7**A) disposed to a second face (e.g., a face facing away from the first face **10401**). The antenna structure **1040** may be electrically coupled with the first wireless communication circuit **1050** of the first PCB **1010** through the FPCB **1020**. According to an embodiment, the first wireless communication circuit **1050** may be similar or identical to the first wireless communication circuit **750** of FIG. **7**A.

According to an embodiment, the metal cover **1030** and the metal sheet **1060** may utilize a second ground layer of the FPCB **1020** to provide electrical coupling with the first ground layers **1014** and **1015** of the first PCB **1010**. For example, a conductive structure including the metal cover **1030** and the metal sheet **1060** may include at least one of the first conductive structure **481**, second conductive structure **482**, third conductive structure **483**, and fourth conductive structure **484** of FIG. **4**.

Referring to FIG. **10**A and FIG. **10**B, in an embodiment, the metal cover **1030** may include at least one of conductive side walls **1031**, **1032**, **1033**, and **1034** electrically coupled with the first ground layers **1014** and **1015**. The conductive side walls **1031**, **1032**, **1033**, and **1034** may include the first side wall **1031**, the second side wall **1032** separated from the first side wall **1031**, the third side wall **1033** for coupling one end of the first side wall **1031** and one end of the second side wall **1032**, and the fourth side wall **1034** for coupling the other end of the first side wall **1031** and the other end of the second side wall **1032**. For example, the first side wall **1031** and the second side wall **1032**, or the third side wall **1033** and the fourth side wall **1034** may be parallel with each other. According to various embodiments, part of the first side wall **1031**, the second side wall **1032**, the third side wall **1033**, or the fourth side wall **1045** may be omitted.

According to an embodiment, the electronic device **1000** may include at least one of a plurality of connectors **1071**, **1072**, **1073**, **1074**, **1075**, **1076**, **1077**, **1078**, **1079**, and **1080** mounted to the first PCB **1010**. The plurality of connectors **1071**, **1072**, **1073**, **1074**, **1075**, **1076**, **1077**, **1078**, **1079**, and **1080** may be electrically coupled with the first ground layers **1014** and **1015** of the first PCB **1010**, and may be similar or identical to, for example, the first connector **860** or second connector **870** of FIG. **8**A or **8**B. The conductive side walls

1031, **1032**, **1033**, and **1034** of the metal cover **1030** may be joined with the plurality of connectors **1071**, **1072**, **1073**, **1074**, **1075**, **1076**, **1077**, **1078**, **1079**, and **1080** and thus may be electrically coupled with the first ground layers **1014** and **1015**. According to various embodiments, positions or the number of connectors are not limited to those illustrated in FIG. **10**B.

According to an embodiment, the metal cover **1030** may include a conductive third plate **1035** extended from edges of the conductive side walls **1031**, **1032**, **1033**, and **1034**, and the third plate **1035** may be separated from the first PCB **1010**.

Referring to FIG. **10**A and FIG. **10**C, in an embodiment, the metal sheet **1060** may be disposed between the conductive third plate **1035** and the second plate **1002**, and may be joined with the conductive third plate **1035**. According to an embodiment, at least part of the FPCB **1020** may be disposed between the metal sheet **1060** and the conductive third plate **1035**. For example, the conductive third plate **1035** may be extended along the FPCB **1020**, and may have a width W**4** wider than that of the FPCB **1020**. According to various embodiments, the conductive third plate **1035** may not be limited to a size illustrated in FIG. **10**A.

Referring to FIG. **10**C, in an embodiment, the second ground layer of the FPCB **1020** may be electrically coupled with the metal cover **1030** by means of the metal sheet **1060**. For example, in the conductive third plate **1035**, some portions **1035***c* and **1035***d* of a region not overlapping with the FPCB **1020** may be electrically coupled to face the metal sheet **1060**. For example, a conductive material may be disposed between the conductive third plate **1035** and the metal sheet **1060**, and thus the metal cover **1030** and the metal sheet **1060** may be electrically coupled. The metal sheet **1060** may be electrically coupled with the second ground layer of the FPCB **1020**. According to an embodiment, the metal sheet **1060** and the second ground of the FPCB **1020** may be electrically coupled utilizing the embodiment of FIG. **7**C. For example, the FPCB **1020** may include at least one exposure region (e.g., the exposure regions **723** and **724**) facing the metal sheet **1060**. A conductive material may be disposed between the metal sheet **1060** and at least one exposure region, and the second ground of the FPCB **1020** may be electrically coupled with the metal sheet **1060**.

According to various embodiments, the metal sheet may not be limited to a position, size, or count illustrated in FIG. **10**A.

According to some embodiments, the metal sheet **1060** may be omitted, and a second ground layer of the FPCB **1020** may be electrically coupled with the metal cover **1030**. For example, the FPCB **1020** may include at least one exposure region (e.g., the exposure regions **723** and **724** of FIG. **7**C) facing the conductive third plate **1035**. A conductive material may be disposed between the conductive third plate **1035** and the at least one exposure region, and thus the second ground layer of the FPCB **1020** may be electrically coupled with the metal cover **1030**.

According to an embodiment, if the second ground layer of the FPCB **1020** is electrically coupled with the first ground layers **1014** and **1015** of the first PCB **1010** through the metal cover **1030** and the metal sheet **1060**, when signals (e.g., IF signals and LO signals) are transmitted/received through the FPCB **1020** between the first wireless communication circuit **1050** and the antenna structure **1040**, electromagnetic noise generated from the inside of the electronic device **1000** or introduced from the outside of the electronic device **1000** can be prevented from and/or reduce affecting transmission/reception of such a signal.

According to an embodiment, if the second ground layer of the FPCB **1020** is electrically coupled with the first ground layers **1014** and **1015** of the first PCB **1010** by means of the metal cover **1030** and the metal sheet **1060**, EMI between the FPCB **1020** and its peripheral circuit can be decreased.

For example, referring to FIG. **10**C, in an embodiment, the metal cover **1030** may provide an electromagnetic shield space **1035***e* formed by the conductive side walls **1031**, **1032**, **1033**, and **1034** and the conductive plate **1035**. The at least one electronic element **1080** mounted to the first PCB **1010** may be disposed to the electromagnetic shield space **1035***e*. The metal cover **1030** and the metal sheet **1060** may decrease EMI between the FPCB **1020** and at least one electronic element **1080** by electrically coupling the second ground of the FPCB **1020** and the first ground layers **1014** and **1015** of the first PCB **1010**.

According to an embodiment, if the second ground layer of the FPCB **1020** is electrically coupled with the first ground layers **1014** and **1015** of the first PCB **1010** by means of the metal cover **1030** and the metal sheet **1060**, EMI between elements may be decreased to reduce a loss for transmission/reception signals (e.g., IF signals and/or LO signals) between the first wireless communication circuit **1050** and the antenna structure **1040**.

According to various embodiments, various other conductive structures for expanding a ground may be electrically coupled between the second ground layer of the FPCB **1020** and the first ground layers **1014** and **1015** of the first PCB **1010**.

FIG. **11** is a perspective view illustrating an example electronic device including a shield member and/or a conductive structure for electrically coupling ground layers of an FPCB and a ground layer of a PCB according to an embodiment. FIG. **12** is a cross-sectional view of section E in FIG. **11**.

Referring to FIG. **11**, according to an embodiment, an electronic device **1100** may include at least one of a first PCB **1110**, a plurality of antenna structures **1141**, **1142**, and **1143**, a plurality of FPCBs **1121**, **1122**, and **1123**, a third PCB **1151**, one or more connectors **1190**, and a conductive structure **1130**.

According to an embodiment, the first PCB **1110** may be joined with a first support member **1195** (e.g., the first support member **311** of FIG. **3**). The first support member **1195** may be coupled with the side member **1190** (e.g., the side member **310** of FIG. **3**) or may be constructed integrally with the side member **1190**. The side member **1190** may include a first side member **1191**, second side member **1192**, third side member **1193**, and fourth side member **1194** which surround a space between a first plate (e.g., the first plate **701** of FIG. **7**A) and a second plate (e.g., the second plate **702** of FIG. **7**A). The first side member **1191** may be parallel with the second side members **1192** and may be spaced apart and arranged side by side in a y-axis direction. The third side member **1193** may be parallel with the fourth side member **1194** and may be spaced apart and arranged side by side in an x-axis direction. According to an embodiment, the first support member **1195** may be a mid-plate or bracket which points to an inner portion surrounded by the side members **1191**, **1192**, **1193**, and **1194** of the side member **1190**.

According to an embodiment, the first PCB **1110** (e.g., the first PCB **710** of FIG. **7**A) may include a first portion **1110***a* and a second portion **1110***b* extendedly protruding from the first portion **1110***a*. According to an embodiment, the first portion **1110***a* may be disposed between the first side member **1191** and a battery **1196** (e.g., the battery **350** of FIG. **3**), and the second portion **1110***b* may be disposed between the fourth side member **1194** and the battery **1196**.

According to an embodiment, the plurality of antenna structures **1141**, **1142**, and **1143** may include the first antenna structure **1141** and third antenna structure **1143** disposed to at least partially overlap with the second portion **1110***b* of the first PCB **1110**, and the second antenna structure **1142** disposed to at least partially overlap with the first portion **1110***b* of the first PCB **1110**. For example, when viewed in a z-axis direction, the first antenna structure **1141** may be disposed adjacent (e.g., within about 10 mm) to the fourth side member **1194**, the second antenna structure **1142** may be disposed adjacent to the third side member **1193**, the third antenna structure **1143** may be disposed adjacent to the first side member **1191**.

According to an embodiment, the first antenna structure **1141** (or the second antenna structure **1142**) or the third antenna structure **1143** may include one of the antenna modules **421**, **422**, **423**, and **424** of FIG. **4** or the antenna structure **740** of FIG. **7**A.

According to an embodiment, the plurality of FPCBs **1121**, **1122**, and **1123** may include the first FPCB **1121** for electrically coupling the first antenna structure **1141** and the third PCB **1151**, the second FPCB **1121** for electrically coupling the second antenna structure **1142** and the third PCB **1151**, or the third FPCB **1123** for electrically coupling the third antenna structure **1143** and the third PCB **1151**. For example, the first FPCB **1121** or the third FPCB **1123** may be extended in a first direction (e.g., a y-axis direction) **1101** between the first side member **1191** and the second side member **1192**, and the second FPCB **1122** may be extended in a second direction (e.g., an x-axis direction) **1102** perpendicular to the first direction **1101**. According to an embodiment, the first FPCB **1121** (or the second FPCB **1122** or the third FPCB **1123**) may include one of the first FPCB **431**, second FPCB **432**, third FPCB **433**, and fourth FPCB **434** of FIG. **4**.

According to an embodiment, the first FPCB **1121**, the second FPCB **1122**, or the third FPCB **1123** may be electrically coupled with one or more connectors **1190** mounted to the third PCB **1151**.

According to an embodiment, the third PCB **1151** may be disposed to at least partially overlap with the first PCB **1110**. For example, the third PCB **1151** may overlap with some regions of the second portion **1110***b* adjacent to the first portion **1110***a*, may overlap with some regions of the first portion **1110***a* adjacent to the second portion **1110***b*.

Referring to FIG. **11** and FIG. **12**, according to an embodiment, an interposer **1170** may be disposed between the first PCB **1110** and the third PCB **1151**, and may electrically couple the first PCB **1110** and the third PCB **1151**.

According to an embodiment, the interposer **1170** may include a non-conductive housing **1171**, and the non-conductive housing **1171** may include a front face **1172** facing the third PCB **1151** and a rear face **1173** facing the first PCB **1110**. The interposer **1170** may include one or more conductors for providing electrically coupling between the front face **1172** and the rear face **1173**. For example, the one or more conductors may include one or more first terminals (not shown) disposed to the front face **1172** of the housing **1171**, one or more second terminals (not shown) disposed to the rear face **1173** of the housing **1171**, and a conductive path which is disposed on an outer face or inside of the housing **1171** and which electrically couples the one or more first terminals and the one or more second terminals. A conducive material such as a solder may be disposed between the one or more first terminals and corresponding terminals of the third PCB **1151** or between the one or more second terminals and corresponding terminals of the first PCB **1110**.

According to various embodiments, the interposer **1170** may include a PCB including one or more inner layers on which a circuit is formed by using Copper Clad Laminates (CCL), first and second outer layers which are disposed at both sides of the inner layers and on which a circuit is formed, or prepregs which bond or isolate one layer from another. For example, the circuit included in the first outer layer may include first terminals electrically coupled with the third PCB **1151**, and the circuit included in the second outer layer may include second terminals electrically coupled with the first PCB **1110**. A conductive material such as a solder may be disposed between the one or more first terminals and corresponding terminals of the third PCB **1151** or between the one or more second terminals and corresponding terminals of the first PCB **1110**.

Referring to FIG. **12**, according to an embodiment, the first PCB **1110** may include a first face **1110***c* facing the third PCB **1151** or a second face **1110***d* facing away from the first face **1110***c*. The third PCB **1151** may include a fourth face **1151***b* facing the first PCB **1110** or a third face **1151***a* facing away from the fourth face **1151***b*. According to an embodiment, a processor **1111** (e.g., the processor **120** of FIG. **1** or the processor **440** of FIG. **4**) may be disposed on the second face **1110***d* of the first PCB **1110**. According to an embodiment, a first power management circuit (e.g., Power Management Integrated Circuit (PMIC)) **1112** or at least one element (e.g., passive element or active element) **1113** may be disposed on the first face **1110***c* of the first PCB **1110**. According to an embodiment, a first wireless communication circuit **1150** (e.g., the first wireless communication circuit **750** of FIG. **7**A or the second communication module **452** of FIG. **4**) or a second power management circuit (e.g., PMIC) **1153** may be disposed on a third face **1151***a* of the third PCB **1151**.

Referring to FIG. **11** and FIG. **12**, in an embodiment, the first wireless communication circuit **1150** and the antenna structures **1141**, **1142**, and **1143** may exchange signals (e.g., IF signals and LO signals) for a corresponding network (e.g., a 5G network) through the FPCBs **1121**, **1122**, and **1123**.

According to an embodiment, the first power management circuit **1112** may manage power supplied to elements (e.g., the third PCB **1151**). The second power management circuit **1153** may manage power supplied to elements (e.g., the first wireless communication circuit **1150**) mounted to the second PCB **1151**.

According to an embodiment, a first shield member (e.g., a shield cover or a shield can) **1160** may be joined with the third PCB **1151** to cover elements (e.g., the first wireless communication circuit **1150**, the second power management circuit **1153**) disposed on the third PCB **1151**. According to an embodiment, the first shield member **1160** may be electrically coupled with a ground layer (not shown) of the third PCB **1151**. The first wireless communication circuit **1150** may be disposed to an electromagnetic shield space **1161** prepared by the first shield member **1160**, and may decrease an influence of electromagnetic noise generated from the inside of the electronic device **1100** or introduced from the outside of the electronic device **1100** on the first wireless communication circuit **1150** or the second power management circuit **1153**.

According to various embodiments, a second shield member **1180** may be joined with the first PCB **1110** to cover the processor **1111** disposed on the first PCB **1110**. According to an embodiment, the second shield member **1180** may be electrically coupled with the ground layer of the first PCB **1110**. The processor **1111** may be disposed to an electromagnetic shield space **1181** prepared by the second shield member **1180**, and may decrease an influence of electromagnetic noise generated from the inside of the electronic device **1100** and introduced from the outside of the electronic device **1100** on the processor **1111**.

According to various embodiments, a thermal conductive material may be disposed between the second shield member **1180** and the processor **1111**, and heat generated from the processor **1111** may be released to the outside through the second shield member **1180**.

Referring to FIG. **11** and FIG. **12**, in an embodiment, the first shield member **1160** may be disposed between the first FPCB **1121** and the third FPCB **1151**, and may be electrically coupled with a ground layer (not shown) of the first FPCB **1121**. According to an embodiment, the ground layer of the first FPCB **112** may be electrically coupled with the first shield member **1160** utilizing an embodiment of FIG. **7**C. For example, the first FPCB **1121** may include at least one exposure region (e.g., exposure regions **723** and **724** of FIG. **7**C), and a conductive material may be disposed between the first shield member **1160** and at least one exposure region.

According to an embodiment, if the ground layer of the first FPCB **1121** is electrically coupled with the ground layer of the third PCB **1151** through the first shield member **1160**, when signals (e.g., IF signals and LO signals) are transmitted/received through the first FPCB **1121** between the first wireless communication circuit **1150** and the first antenna structure **1141**, electromagnetic noise generated from the inside of the electronic device **1100** or introduced from the outside of the electronic device **1100** can be prevented from and/or reduce affecting transmission/reception of such a signal.

According to an embodiment, the conductive structure **1130** (e.g., the conductive structure **730** of FIG. **7**A) may electrically couple a ground layer (e.g., the first ground layers **714** and **715** of FIG. **7**A) of the first PCB **1110** and a ground layer (not shown) of the second FPCB **1122**. According to an embodiment, the conductive structure **1130** may be disposed between the second FPCB **1121** and the first PCB **1110**, and may be electrically coupled with the FPCB **1122**. According to some embodiments, the second FPCB **1122** may be disposed between the conductive structure **1130** and the first PCB **1110**, and may be electrically coupled with the conductive structure **1130**.

According to an embodiment, the conductive structure **1130** and the ground layer the second FPCB **1122** may be electrically coupled utilizing the embodiment of FIG. **7**C. For example, the second FPCB **1122** may include at least one exposure region (e.g., exposure regions **723** and **724** of FIG. **7**C), and a conductive material may be disposed between the conductive structure **1130** and at least one exposure region.

According to an embodiment, the conductive structure **1130** may be utilized as a support which props the second FPCB **1122**, and the second FPCB **1122** may maintain a state of being separated from the first PCB **1110**.

According to an embodiment, if the ground layer of the second FPCB **1122** is electrically coupled with the ground layer of the first PCB **1100** through the conductive structure **1130**, when signals (e.g., IF signals and LO signals) are transmitted/received through the second FPCB **1122** between the first wireless communication circuit **1150** and the second antenna structure **1142**, electromagnetic noise generated from the inside of the electronic device **1100** or introduced from the outside of the electronic device **1100** can be prevented from and/or reduce affecting transmission/reception of such a signal.

According to an embodiment, the electronic device **1100** may further include a third shield member **1169** disposed between the second FPCB **1122** and the first PCB **1110**. The third shield member **1169** may be electrically coupled with the ground layer of the first PCB **1110**. According to an embodiment, the third shield member **1169** may provide an electromagnetic shield space which covers electronic elements mounted on the first PCB **1110**. According to an embodiment, the third shield member **1169** may support the second FPCB **1122**, and the second FPCB **1122** may maintain a state of being spaced apart from the first PCB **1110**. According to various embodiments, in order to decrease an electromagnetic influence between elements, the ground layer of the second FPCB **1122** may be electrically coupled with the third shield member **1169**.

According to an embodiment, the third FPCB **1123** may have a relatively shorter length than the first FPCB **1121** or the second FPCB **1122**. Due to such an electrical length, an influence of electromagnetic noise generated from the inside of the electronic device **1100** or introduced from the outside of the electronic device **1100** on the third FPCB **1123** may be below a specific level. In the embodiment of FIG. **11**, a conductive structure (e.g., the conductive structure **730** of FIG. **7**A) which electrically couples the ground layer of the third FPCB **1123** and the ground layer of the first FPCB **1110** is not included. However, according to an embodiment, the conductive structure may be added to electrically couple the ground layer of the third FPCB **1123** and the ground layer of the first FPCB **1110**.

According to an embodiment of the disclosure, an electronic device (e.g., the electronic device **700** of FIG. **7**A) may include a housing including a first plate (e.g., the first plate **701** of FIG. **7**A), a second plate (e.g., the second plate **702** of FIG. **7**A) facing away from the first plate, and a side member (e.g., the side member **703** of FIG. **7**A) surrounding a space between the first plate and the second plate and joined to the second plate or constructed integrally with the second plate. The electronic device **700** may include a display (e.g., the display **704** of FIG. **7**A) visible through at least part of the first plate, a first Printed Circuit Board (PCB) (e.g., the first PCB **710** of FIG. **7**A) disposed between the first plate and the second plate and including at least one first ground layer (e.g., the first ground layers **714** and **715** of FIG. **7**A), and a Flexible Printed Circuit Board (FPCB) (e.g., the FPCB **720** of FIG. **7**A) at least partially overlapping with the first PCB when viewed from above the first plate. The FPCB may include a first end (e.g., the first end **721** of FIG. **7**A) electrically coupled to the first PCB, a second end (e.g., the second end **722** of FIG. **7**A), and at least one second ground layer (not shown). The electronic device may include a conductive structure (e.g., the conductive structure **730** of FIG. **7**A) disposed between the first PCB and the FPCB and electrically coupling the first ground layer and the second ground layer.

According to an embodiment of the disclosure, the electronic device (e.g., the electronic device **700** of FIG. **7**A) may further include an antenna structure (e.g., the antenna structure **740** of FIG. **7**A) electrically coupled to the second end (e.g., the second end **722** of FIG. **7**A) and disposed between the first plate (e.g., the first plate **701** of FIG. **7**A) and the second plate (e.g., the second plate **702** of FIG. **7**B). The antenna structure may include a second PCB (e.g., the second PCB **742** of FIG. **7**A) including a first face (e.g., the first face **7401** of FIG. **7**A) and a second face (not shown) facing away from the first face, and at least one conductive pattern (e.g., the conductive patterns **743** and **744** of FIG. **7**A) disposed on the first face and/or the second face in the second PCB.

According to an embodiment of the disclosure, the at least one conductive pattern (e.g., the conductive patterns **743** and **744**) may include an antenna array.

According to an embodiment of the disclosure, the second PCB (e.g., the second PCB **742** of FIG. **7**A) may be disposed in the space such that the first face (e.g., the first face **7401** of FIG. **7**A) or the second face faces the second plate (e.g., the second plate **702** of FIG. **7**A) or the side member (e.g., the side member **703** of FIG. **7**A).

According to an embodiment of the disclosure, the first end (e.g., the first end **721** of FIG. **7**A) may be coupled to a first connector (e.g., the first connector **711** of FIG. **7**A) disposed to the first PCB (e.g., the first PCB **710** of FIG. **7**A), and the second end (e.g., the second end **722** of FIG. **7**A) may be coupled to a second connector (e.g., the second connector **741** of FIG. **7**A) disposed to the second PCB (e.g., the second PCB **742** of FIG. **7**A).

According to an embodiment of the disclosure, the electronic device (e.g., the electronic device **700** of FIG. **7**A) may include a first wireless communication circuit (e.g., the first wireless communication circuit **750** of FIG. **7**A) disposed to the first PCB (e.g., the first PCB **710** of FIG. **7**A) and electrically coupled to the first end (e.g., the first end **721** of FIG. **7**A), and a second wireless communication circuit (e.g., the second wireless communication circuit **745**) disposed to the second PCB (e.g., the second PCB **742** of FIG. **7**A) and electrically coupled to the second end (e.g., the second end **722** of FIG. **7**A).

According to an embodiment of the disclosure, the first wireless communication circuit (e.g., the first wireless communication circuit **750** of FIG. **7**A) may include an Intermediate Frequency Integrated Circuit (IFIC), and the second wireless communication circuit (e.g., the second wireless communication circuit **745** of FIG. **7**A) may include a Radio Frequency Integrated Circuit (RFIC).

According to an embodiment of the disclosure, the first wireless communication circuit (e.g., the first wireless communication circuit **750** of FIG. **7**A) may transmit and/or receive a first signal having a frequency between about 5 GHz and about 15 GHz, and the second wireless communication circuit (e.g., the second wireless communication circuit **745** of FIG. **7**A) may transmit and/or receive a second signal having a frequency between about 24 GHz and about 100 GHz.

According to an embodiment of the disclosure, the at least one conductive pattern (e.g., the conductive patterns **743** and **744** of FIG. **7**A) may include a first antenna element and a second antenna element disposed to be spaced apart from the first antenna element. The second wireless communication circuit (e.g., the second wireless communication circuit **745** of FIG. **7**A) may include a first electrical path electrically coupled to a first point on the first antenna element, and a second electrical path electrically coupled to a second point on the second antenna element. The second wireless communication circuit may provide a phase difference between the first signal at the first point and the second signal at the second point.

According to an embodiment of the disclosure, the electronic device (e.g., the electronic device **1100** of FIG. **11**) may further include a third PCB (e.g., the third PCB **1151** of FIG. **11** or **12**) disposed at least overlapping with the first PCB (e.g., the first PCB **1110** of FIG. **11** or **12**) and electrically coupled with the first PCB **1110**. The third PCB **1151** may include a wireless communication circuit (e.g., the first wireless communication circuit **1150** of FIG. **12**) electrically coupled to the antenna structure (e.g., the antenna structure **1142** of FIG. **11**) through the FPCB (e.g., the FPCB **1122** of FIG. **11**).

According to an embodiment of the disclosure, the electronic device (e.g., the electronic device **1100** of FIG. **11**) may include an interposer (e.g., the interposer **1170** of FIG. **11** or **12**) disposed between the first PCB (e.g., the first PCB **1110** of FIG. **11** or **12**) and the third PCB (e.g., the third PCB **1151** of FIG. **11** or **12**).

According to an embodiment of the disclosure, the conductive structure (e.g., the conductive structure **730** of FIG. **7**A or **7**B) may include a first conductive portion (e.g., the first conductive portion **731** of FIG. **7**B) electrically coupled at a first position of the first ground layer (e.g., the first ground layers **714** and **715** of FIG. **7**A), a second conductive portion (e.g., the second conductive portion **732** of FIG. **7**B) electrically coupled at a second position, different from the first position, of the first ground layer, and a third conductive portion (e.g., the third conductive portion **733** of FIG. **7**B) electrically coupled between the first portion and the second portion and electrically coupled with the second ground layer.

According to an embodiment of the disclosure, the third conductive portion (e.g., the third conductive portion **733** of FIG. **7**A or **7**B) may be spaced apart from the first PCB (e.g., the first PCB **710** of FIG. **7**A or **7**B).

According to an embodiment of the disclosure, the conductive structure (e.g., the conductive structure **730** of FIG. **7**A or **7**B) may include a metal plate in which the first conductive portion (e.g., the first conductive portion **731** of FIG. **7**B), the second conductive portion (e.g., the second conductive portion **732** of FIG. **7**B), and the third conductive portion (e.g., the third conductive portion **733** of FIG. **7**B) are constructed integrally.

According to an embodiment of the disclosure, the FPCB (e.g., the FPCB **720** of FIG. **7**C) may include at least one region (e.g., the exposure regions **723** and **724** of FIG. **7**C) in which the second ground layer is partially exposed, and a conductive material may be disposed between the at least one region and the third conductive portion (e.g., the third conductive portion **733** of FIG. **7**C).

According to an embodiment of the disclosure, an end (e.g., the end **7312** of FIG. **7**B) of the first conductive portion (e.g., the first conductive portion **731** of FIG. **7**B) or an end (e.g., the end **7322** of FIG. **7**B) of the second conductive portion (e.g., the second conductive portion **732** of FIG. **7**B) may be joined with the first PCB (e.g., the first PCB **710** of FIG. **7**B) by using a conductive material.

According to an embodiment of the disclosure, the electronic device may further include a first metal member recess (e.g., the third connector **860** of FIG. **8**B) disposed at the first position of the first ground layer (e.g., the first ground layers **814** and **815** of FIG. **8**A) and including a recess (e.g., the recess **864** of FIG. **8**B) through which the first conductive portion is partially inserted, and a second metal member (e.g., the fourth connector **870** of FIG. **8**B) disposed at the second position of the first ground layer and including a recess (e.g., the recess **874** of FIG. **8**B) through which the second conductive portion (e.g., the second conductive portion **832** of FIG. **8**B) is partially inserted.

According to an embodiment of the disclosure, the FPCB (e.g., the FPCB **820** of FIG. **8**B) may be disposed between the third conductive portion (e.g., the third conductive portion **833** of FIG. **8**B) and the first PCB (e.g., the first PCB **810** of FIG. **8**B).

According to an embodiment of the disclosure, the third conductive portion (e.g., the third plate **1035** of FIG. **10**A) may be disposed between the FPCB (e.g., the FPCB **1020** of FIG. **10**A) and the first PCB (e.g. the first PCB **1010** of FIG. **10**A).

According to an embodiment of the disclosure, the conductive structure (e.g., the metal cover **1030** and metal sheet **1060** of FIG. **10**A) may include a metal cover (e.g., the metal cover **1030** of FIG. **10**A) disposed between the first PCB (e.g., the first PCB **1010** of FIG. **10**A) and the FPCB (e.g., the FPCB **1020** of FIG. **10**A) and electrically coupled to the first ground layer (e.g., the first ground layers **1014** and **1015** of FIG. **10**A), and a metal sheet (e.g., the metal sheet **1060** of FIG. **10**A) electrically coupled to the metal cover. The FPCB may be disposed between the metal cover and the metal sheet, and the second ground layer may be electrically coupled to the metal sheet.

While various example embodiments are disclosed and illustrated in the present disclosure, one skilled in the art will understand that the various example embodiments are intended to be illustrative, not limiting. Therefore, it should be understood that, in addition to the embodiments disclosed herein, all modifications or changed forms derived from the technical idea of the present disclosure fall within the scope of the present disclosure.

What is claimed is:

1. An electronic device comprising:

a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or being integral with the second plate;

a display viewable through at least part of the first plate;

a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer;

a Flexible Printed Circuit Board (FPCB) including a first end electrically coupled to the first PCB, a second end, and at least one second ground layer; and

a conductive structure electrically coupling the first ground layer and the second ground layer, wherein the conductive structure includes:

a first conductive portion electrically coupled at a first position of the first ground layer;

a second conductive portion electrically coupled to the first ground layer at a second position, different from the first position; and

a third conductive portion electrically coupled between the first conductive portion and the second conductive portion, and electrically coupled with the second ground layer, and

wherein the FPCB is disposed between the third conductive portion and the first PCB.

2. An electronic device comprising:

a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or being integral with the second plate;

a display viewable through at least part of the first plate;

a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer;

a Flexible Printed Circuit Board (FPCB) at least partially overlapping the first PCB, wherein the FPCB includes a first end electrically coupled to the first PCB, a second end, and at least one second ground layer;

a conductive structure electrically coupling the first ground layer and the second ground layer, wherein the conductive structure includes:

a first conductive portion electrically coupled at a first position of the first ground layer;

a second conductive portion electrically coupled to the first ground layer at a second position, different from the first position; and

a third conductive portion electrically coupled between the first conductive portion and the second conductive portion, and electrically coupled with the second ground layer; and

an antenna structure comprising at least one antenna electrically coupled to the second end and disposed between the first plate and the second plate, the antenna structure including:

a second PCB including a first face and a second face facing away from the first face; and

at least one conductive pattern disposed on the first face and/or the second face in the second PCB.

3. The electronic device of claim **2**, wherein the at least one conductive pattern includes an antenna array.

4. The electronic device of claim **2**, wherein the second PCB is disposed in the space such that the first face or the second face faces the second plate or the side housing.

5. The electronic device of claim **2**,

wherein the first end is coupled to a first connector disposed to the first PCB, and

wherein the second end is coupled to a second connector disposed to the second PCB.

6. The electronic device of claim **2**, further comprising:

a first wireless communication circuit disposed to the first PCB and electrically coupled to the first end; and

a second wireless communication circuit disposed to the second PCB and electrically coupled to the second end.

7. The electronic device of claim **6**,

wherein the first wireless communication circuit includes an Intermediate Frequency Integrated Circuit (IFIC), and

wherein the second wireless communication circuit includes a Radio Frequency Integrated Circuit (RFIC).

8. The electronic device of claim **6**,

wherein the first wireless communication circuit is configured to transmit and/or receive a first signal having a frequency between about 5 GHz and about 15 GHz, and

wherein the second wireless communication circuit is configured to transmit and/or receive a second signal having a frequency between about 24 GHz and about 100 GHz.

9. The electronic device of claim **6**,

wherein the at least one conductive pattern includes a first antenna element comprising a first antenna and a second antenna element comprising a second antenna disposed to be spaced apart from the first antenna element,

wherein the second wireless communication circuit includes a first electrical path electrically coupled to a first point on the first antenna element, and a second electrical path electrically coupled to a second point on the second antenna element, and the second wireless communication circuit is configured to provide a phase difference between a first signal at the first point and a second signal at the second point.

10. The electronic device of claim **2**, further comprising a third PCB disposed to overlap at least the first PCB and being electrically coupled with the first PCB,

wherein the third PCB includes a wireless communication circuit electrically coupled to the antenna structure through the FPCB.

11. The electronic device of claim **10**, further comprising an interposer disposed between the first PCB and the third PCB.

12. The electronic device of claim **1**, wherein the third conductive portion is spaced apart from the first PCB.

13. The electronic device of claim **1**, wherein the conductive structure includes a metal plate wherein the first conductive portion, the second conductive portion, and the third conductive portion integral with each other.

14. An electronic device comprising:

a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or being integral with the second plate;

a display viewable through at least part of the first plate;

a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer;

a Flexible Printed Circuit Board (FPCB) at least partially overlapping the first PCB, wherein the FPCB includes a first end electrically coupled to the first PCB, a second end, and at least one second ground layer; and

a conductive structure electrically coupling the first ground layer and the second ground layer, wherein the conductive structure includes:

a first conductive portion electrically coupled at a first position of the first ground layer;

a second conductive portion electrically coupled to the first ground layer at a second position, different from the first position; and

a third conductive portion electrically coupled between the first conductive portion and the second conductive portion, and electrically coupled with the second ground layer,

wherein the FPCB includes at least one region in which the second ground layer is partially exposed, and

wherein a conductive material is disposed between the at least one region and the third conductive portion.

15. The electronic device of claim **1**, wherein an end of the first conductive portion or an end of the second conductive portion is joined with the first PCB using a conductive material.

16. The electronic device of claim **1**, further comprising:

a first recess comprising a metal disposed at the first position of the first ground layer and including a recess through which the first conductive portion is partially inserted; and

a second recess comprising a metal disposed at the second position of the first ground layer and including a recess through which the second conductive portion is partially inserted.

17. The electronic device of claim **14**, wherein the FPCB is disposed between the third conductive portion and the first PCB.

18. The electronic device of claim **14**, wherein the third conductive portion is disposed between the FPCB and the first PCB.

19. An electronic device comprising:

a housing including a first plate, a second plate facing away from the first plate, and a side housing surrounding a space between the first plate and the second plate and joined to the second plate or being integral with the second plate;

a display viewable through at least part of the first plate;

a first Printed Circuit Board (PCB) disposed between the first plate and the second plate and including at least one first ground layer;

a Flexible Printed Circuit Board (FPCB) at least partially overlapping the first PCB when viewed from above the first plate, wherein the FPCB includes a first end electrically coupled to the first PCB, a second end, and at least one second ground layer; and

a conductive structure comprising a conductive material disposed between the first PCB and the FPCB and electrically coupling the first ground layer and the second ground layer, wherein the conductive structure includes a metal cover disposed between the first PCB and the FPCB and electrically coupled to the first ground layer, and a metal sheet electrically coupled to the metal cover, and

wherein the FPCB is disposed between the metal cover and the metal sheet, and the second ground layer is electrically coupled to the metal sheet.

* * * * *